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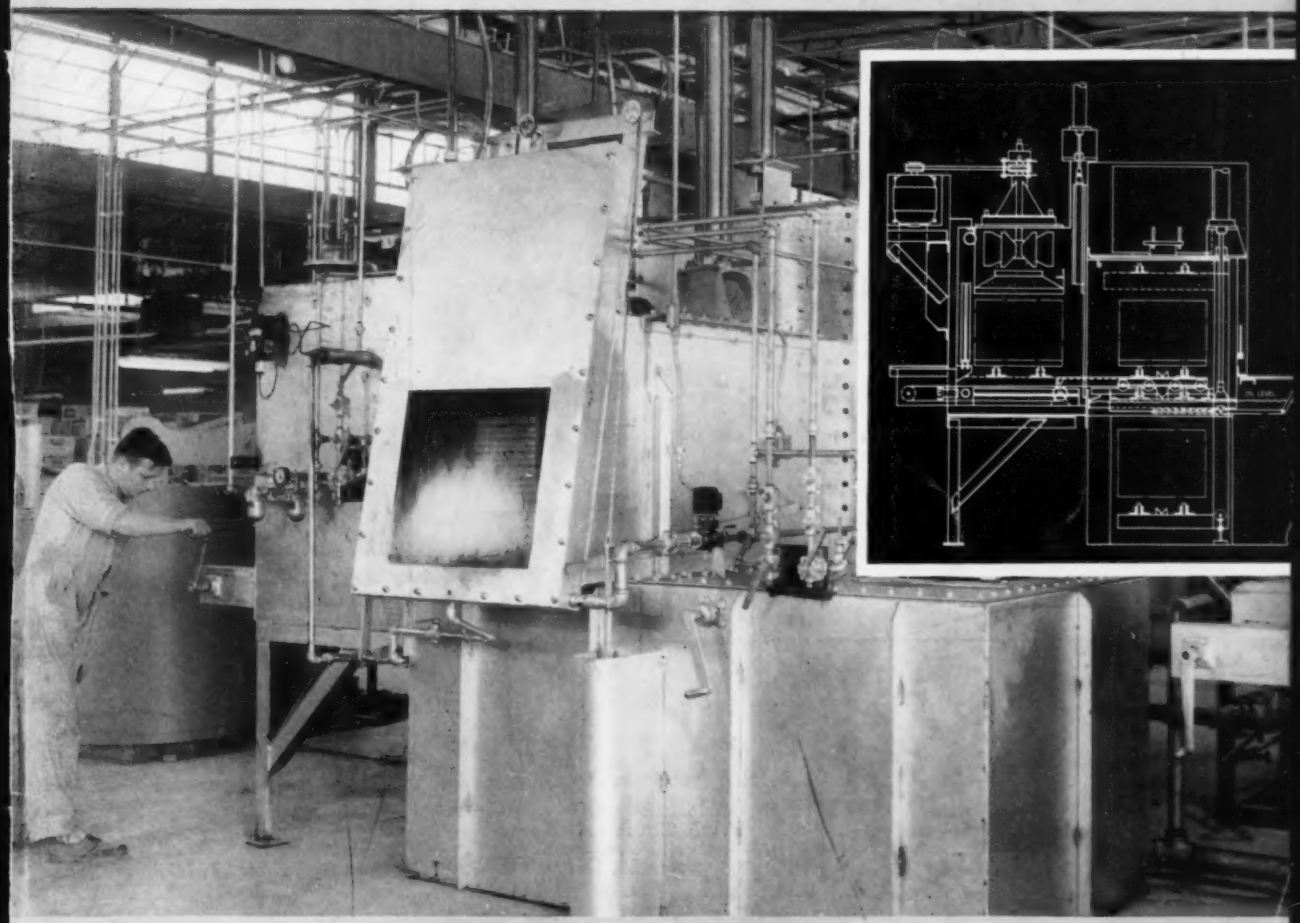

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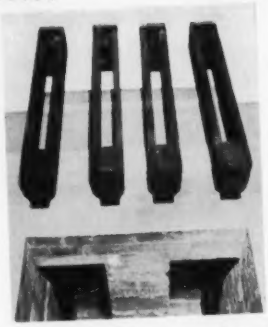

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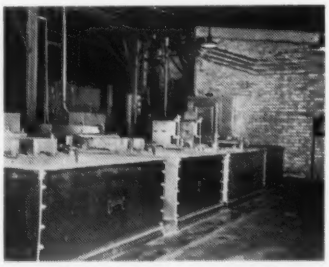

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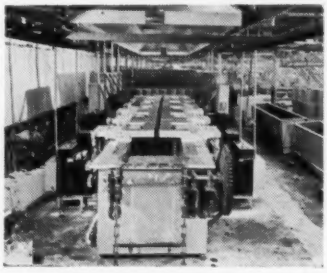

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Indexed in Engineering Index

EDITORIAL

Heat Treater: Once Again Non-Critical

Shortly after the beginning of the Korean conflict the Department of Labor issued a list of essential activities and critical occupations. Conspicuous by its absence was the classification of *Heat Treater.* Immediately, the Metal Treating Institute went into action to see that this error was corrected, and after reviewing the facts presented, the then Secretary of Labor Tobin added specifically "Heat Treater, All Around" to the critical list.

Once again, however, the Department of Labor has issued a revised list from which *Heat Treater* has been removed. Questioned about this, the office of the Assistant Secretary replied, "The committee in its study of this occupation reviewed information on the demand-supply situation received from 55 geographical areas in which heat treating establishments are located, plus data on current defense requirements for items which require heat treatment. Other elements considered had to do with the age and number of draft registrants entering the armed services through the Selective Service System. On the basis of this study, it was the judgment of the committee that the omission of "Heat Treater, All Around," from the List of Currently Critical Occupations would not impede the defense production program or significantly interfere with requirements of the civilian economy."

In view of the fact that a review of the TEN *essential activities* listed showed that SEVEN are basically and specifically dependent upon heat-treated parts or include heat-treating operations, we cannot but feel that the advisory committee has not been fully or accurately informed.

Occupation-wise, we find "Tool and Die Maker" listed and correctly so. We wonder, however, how many tools and dies would be produced for our "essential activities" without the heat treater.

We are going to continue to attempt to rectify this error. If you have facts or figures which can help, let us have them.

C. E. Herington

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Bright Hardening and Bright Tempering of CORROSION-RESISTANT AND HIGH-TEMPERATURE ALLOYS

By **T. W. HARKER,**
Metallurgist, Aero Division
H. M. Harper Company,
Morton Grove, Illinois

Fastenings and bolts for elevated temperature use in gas and steam turbines in turbo-jet aircraft power plants and atomic power applications are highly specialized engineering and metallurgical achievements. Designs are not standardized. Tolerances are necessarily extremely close and mechanical properties are near the limits of forging and machine fabrication ability. (See Fig. 1)

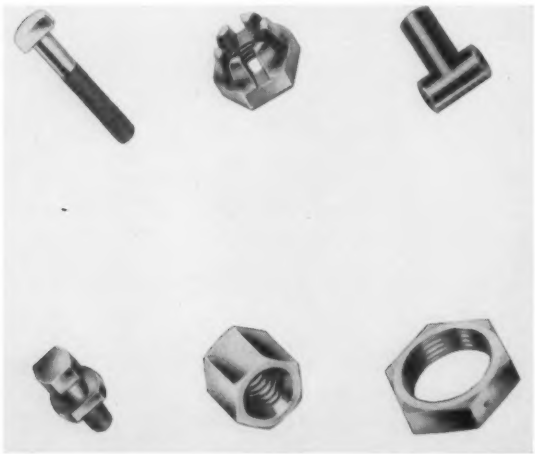

Fig. 1—A typical group of high temperature fastenings for use in gas and steam turbines for turbo-jet aircraft.

Bolts may be produced by either machining from a bar the same size as the head, or by upsetting the head from bar stock about the same diameter as the shank. The threads are then either cut or rolled. High temperature bolting requires rolled threads by most specifications. The notch effect is thus reduced since material is not removed by cutting, but merely displaced.

Austenitic Type Alloys

Most of the high temperature bolting alloys have an austenitic microstructure. Some are capable of precipitation or age hardening. They are used for high temperature applications because of inherent stability of the crystalline structure which results in the retention of unusual strength and hardness at all temperatures.

Proper heat treatment of the alloys used in high temperature bolting and fastening is extremely important and close control of these processes is a highly critical operation requiring precision equipment. In many cases it is a long operation lasting up to 45 hours.

Heat treatments for both age-hardenable and non-age-hardenable alloys of the austenitic type are selected to obtain the optimum strength and stabilized properties required. With age-hardenable austenitic alloys, two types of heat treatments are required:

1. *Solution heat treatment*—to recrystallize and refine grain structure and to put the precipitant in solution. It also softens metal for ease of subsequent machining and forming.

2. *Aging*—hardening at a temperature or combination of temperatures from 1200-1600F. This type of hardness is retained in service at temperatures below the minimum aging temperature.

It is customary to roll threads when the metal is in the solution heat treated condition because this

increases the number of slip planes. Aging or precipitation hardening takes place along the slip lines or planes of crystal movement which means increased hardness and strength.

The non-hardenable austenitic alloys are either stress relieved or annealed after cold working to return the metal to a stable condition. This reduces the internal or residual stresses without an appreciable decrease in hardness. At the same time, it increases the yield strength of the metal at room temperature.

Batch Type Heat Treat Equipment

To carry out these heat treatments under precise control of temperature and material surface condition, two Allcase radiant tube equipped controlled atmosphere furnaces are used. Practically all annealing, aging and solution heat treating required for the production of the Aero Division of H. M. Harper Company are processed in these furnaces.

These Allcase furnaces, designed and built by Surface Combustion Corporation, Toledo, Ohio, are gas-fired radiant tube heated units. The two furnaces are normally used in a range between 900-1800F. One furnace has a circulating fan in the heating chamber and the maximum temperature on this furnace is 1750F. The restriction on the maximum temperature is primarily due to fan life. In the other furnace there is no circulating fan in the heating zone so that the maximum temperature for this furnace is 1800F. Both furnaces have been used in the range of 1100F. for drawing and age hardening. However, the furnace with the fan in the heating chamber is normally used in the lower temperature ranges from approximately 900-1500F.

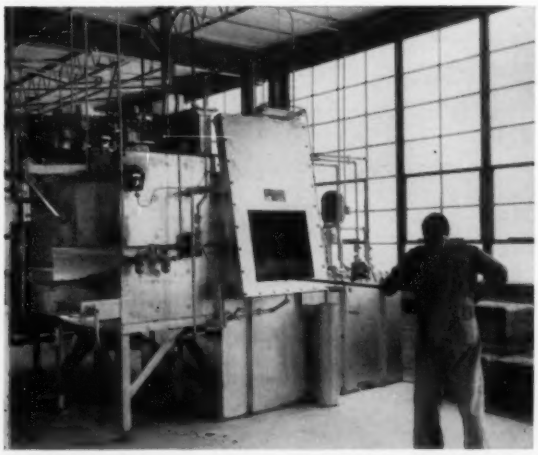

Fig. 2—Operator charging basket load of fastenings into vestibule over quench tank. This can be done while another charge either rests in quench tank or in cooling chamber to left of vestibule.

They are also equipped with hooded quench vestibules with 900 gallon oil quench tank with an air cylinder-operated elevator. (See Fig. 2) A propeller-type agitator in this tank rapidly circulates large quantities of oil through a baffle arrangement resulting in a downward flow of oil through the work. Flow in this direction is ideal for small parts such as fastenings when treated in basket loads of loose parts.

A charge consists of two trays with loaded baskets coupled together as a single unit. (See Fig. 3) The

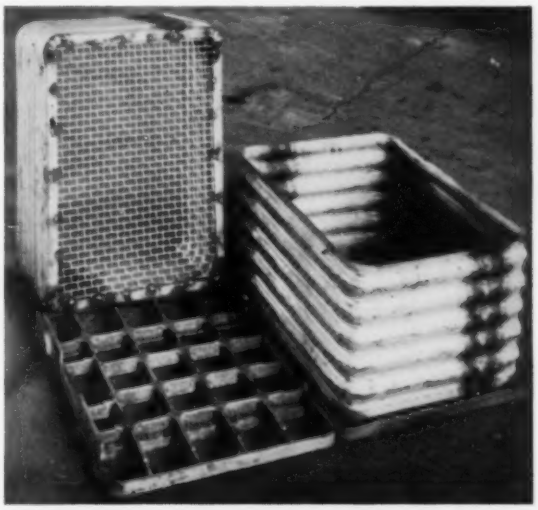

Fig. 3—Basket tray arrangement used for handling the bolts and fastenings. Trays are coupled together to function as a single unit.

heating chamber, with effective area of 24 x 36 inches, accommodates both trays at one time. Entire charge is also quenched at one time on the bottom level of the double-tier quench elevator, permitting the charging of a new load while the first is cooling in the quench tank. The result is the shortest possible cycle and the maximum "on-the-line" productive furnace time. Loads vary from 100-500 lbs. per charge depending on process and type and size of parts being treated.

The atmosphere that is normally used is about 95% nitrogen and 5% hydrogen for all heat treatments. The hydrogen contents are kept low primarily for safety reasons in the lower temperature regions. The dew point is maintained at minus 50F. which is measured at the entrance to the furnace.

Basic Process Cycles

The production cycles, including heat treatments, can be broken down into three basic types determined by the type of alloy being processed:

A. *Austenitic Alloys*— (*Non-Hardenable*)
Raw material is cold drawn wire or rod.
1. Cold head
2. *Anneal* at 1825-1900F from 10 min. to 1 hour at temperature, atmosphere 95% nitrogen and 5% hydrogen. The dew point is held to —50F measured at the furnace entrance. This applies to all heat treatments.

(*Continued on page 4*)

BRIGHT HARDENING (cont.)

Quench in oil. (Hardness and microstructure checked).

3. Clean to remove quench oil and rinse. Dry in hot air. (Size is checked).
4. Finish forming operations.
5. *Stress relieve* after thread rolling at 700F in atmosphere 95% nitrogen, 5% hydrogen. The dew point is held to −50F measured at the furnace entrance.

   At temperature 1-4 hours in this low temperature treatment, the parts do not come out bright, but clean. There is a slight discoloration, but no scale. It has been found at these low temperatures that about a 5% hydrogen content gives the cleanest work.

B. *Austenitic Alloys*—(*Hardenable*)

Raw material is cold drawn wire or rod.

1. Cold head
2. Solution heat treat at 1800F for 1 hour at temperature, atmosphere 95% nitrogen and 5% hydrogen. The dew point is held to −50F measured at the furnace entrance. Quench in oil. (Hardness and microstructure checks). (See Fig. 4)

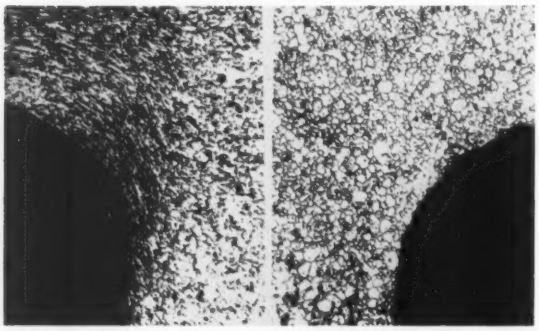

Fig. 4—Microstructure of A-286 alloy before and after solution heat treatment. On the left is structure after heading and before any thermal treatment. Note the grain flow and strained structure with obscure grain boundaries. On the right is structure after heat treatment and aging. 1 hour at 1800F—oil quench; 16 hours at 1325F—air cool. Note equiaxed structure with a no. 6 ASTM grain size.

3. Clean to remove quench oil and rinse. (Size is checked).
4. Finish forming operations.
5. *Age harden* at 1200-1600F for 16-45 hours at temperature, atmosphere 95% nitrogen and 5% hydrogen. The dew point is held to −50F measured at the furnace entrance. Quench in oil. (Hardness and microstructure checks).

   Cooled in atmosphere cooling chamber until room temperature. (Hardness 23-33 Rockwell C. tensile of 130,000 psi or more)
6. Ready to ship.

C. *Martensitic Alloys*

Raw material is cold drawn wire or rod.

1. Cold head
2. Finish machine
3. *Harden* at 1800F for ½ hour at temperature, atmosphere 95% nitrogen and 5% hydrogen. The dew point is held to −50F measured at the furnace entrance. Oil quench. (Hardness above 40 R.C.)
4. Clean to remove quench oil. (Checked for size).
5. *Draw* at 700-1400F for 1-4 hours at temperature, atmosphere 95% nitrogen and 5% hydrogen. The dew point is held to −50F measured at the furnace entrance. Quench in oil. (Hardness and microstructure checks). Cool in atmosphere cooling chamber. (Hardness above 20 R.C. tensile above 125,000 psi).
6. Roll thread if required.
7. Ready to ship.

Heat treatment is of fundamental importance as it affects dimensional, physical and external characteristics of the parts. Results must be accurate within highly rigid tolerances and highly uniform from piece to piece in any load, and from charge to charge in any large scale run. The flexibility of the gas-fired controlled atmosphere furnace with enclosed quench and controlled atmosphere cooling chamber has made it possible to achieve and maintain this necessarily high standard of production.

■ ■ ■

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Principles and

APPLICATIONS OF STEP QUENCHING

(Martempering)

By **RICHARD F. HARVEY**
Rehoboth, Massachusetts

Editor's Note: *Metallurgy evolved from the status of a secret craft to an exacting science during the early 1900's. Principles developed by Bain and Davenport in 1930 led to the first understanding of the isothermal transformation of austenite. Austempering, introduced by United States Steel Corporation in 1933, and martempering were the names given to the treatments in accordance with the principles developed by Bain and Davenport.*

R. F. Harvey, in 1938, demonstrated the benefits of step quenching (martempering) of hack-saw blades which were then straighter and tougher than regularly hardened blades. Finally, in 1940, Greninger and Troiano showed that the formation of martensite from austenite is not an isothermal reaction but depends for its continuation on a decrease in temperature.

Scientific heat treatment is a recent development which has its roots in the fundamental knowledge of the changes which occur when steel is quenched or otherwise cooled from above its critical temperature to room temperature. Our knowledge of heat treating and in particular hardening has been clarified through research so that we now have a better understanding of exactly what occurs when a piece of steel is hardened. A chart which shows the changes which take place when steels are cooled or quenched from the critical temperature must include the element of time as well as temperature to represent nonequilibrium conditions such as exist during quenching. Such charts showing the transformation or structural changes which occur on cooling or quenching are called S-curves because of their shape. They are also known as isothermal transformation diagrams, or T-T-T curves, the letters representing time-temperature-transformation.

Fig. 1 illustrates such a transformation diagram for an oil hardening steel of the following composition: Carbon 0.90%, Manganese 1.30%, Chromium 0.50%, and Tungsten 0.50%. A brief explanation of how these curves are constructed and what they mean in terms of specific examples of different cooling rates will be helpful in understanding the principles underlying the transformation diagrams.

When steel is heated above its critical temperature it changes from ferrite to austenite. Austenite is stable above the critical temperature. When the steel is cooled below the critical temperature the austenite is unstable and transforms to another more stable form. When transformation occurs at elevated temperatures the end product is pearlite which is a lamelar mixture of ferrite and iron carbide. Pearlite appears as alternate plates of ferrite and carbide under the microscope and is quite soft.

At lower temperature levels generally from about 800° F. down to about 500° F. another austenite transformation product appears which is generally termed Bainite. This is an acicular ferrite-carbide aggregate of moderate hardness generally about Rockwell C 45 to about Rockwell C 54.

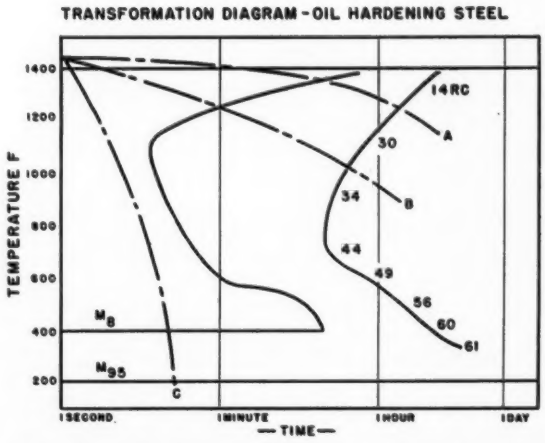

Fig. 1—Typical time-temperature-transformation diagram for an oil hardening steel.

As the temperature of transformation is lowered further a point is reached at which the austenite starts to transform directly to a hard acicular structure termed martensite. The temperature at which this transformation starts is known as the M_s point and the temperature at which the transformation to martensite is essentially completed is known as the M_f point. (More specifically, in the steel illustrated in Fig. 1, 200° F. represents the

temperature at which about 95% of the transformation to martensite is completed and this is sometimes referred to as the M_{95} point.) It should be noted that the transformation to martensite is not an isothermal process but depends on a lowering in temperature for its continuation.

Two curves are generally shown, one to represent the start of transformation and the other to represent the completion of transformation. In the construction of such a diagram specimens are quenched into a salt bath held at the various temperatures for various times followed by quenching rapidly to room temperature. The progress of the transformation at each temperature level may be determined by microscopic analysis or by magnetic means.

It will be noted that the subcritical austenite will exist for a short time at about 1000° F. at which temperature level transformation to pearlite occurs rapidly. In the temperature range somewhat above about 400° F. the austenite will exist for longer periods of time before it starts to transform.

If the steel illustrated in Fig. 1 is quenched at 1100° F. and held at that temperature it will start to transform at 10 seconds and will be completely transformed after about 45 minutes. If the steel is quenched and held at 500° F. transformation will start in about 9 minutes and will be complete after holding for about 2 hours.

If the steel is cooled slowly from above the critical temperature as along path A transformation will take place at a high temperature after a considerable period of time resulting in soft, pearlitic structure.

If the steel is cooled somewhat more rapidly as along path B the transformation of austenite will start sooner and will be completed in less time. The product of transformation will still be pearlite but it will be harder and the laminations will be more closely spaced.

If the steel is cooled more rapidly as along path C there will be no transformation until the steel reaches a temperature of slightly less than 400° F. where martensite starts to form. Martensite is the hardest of the transformation products and is us-

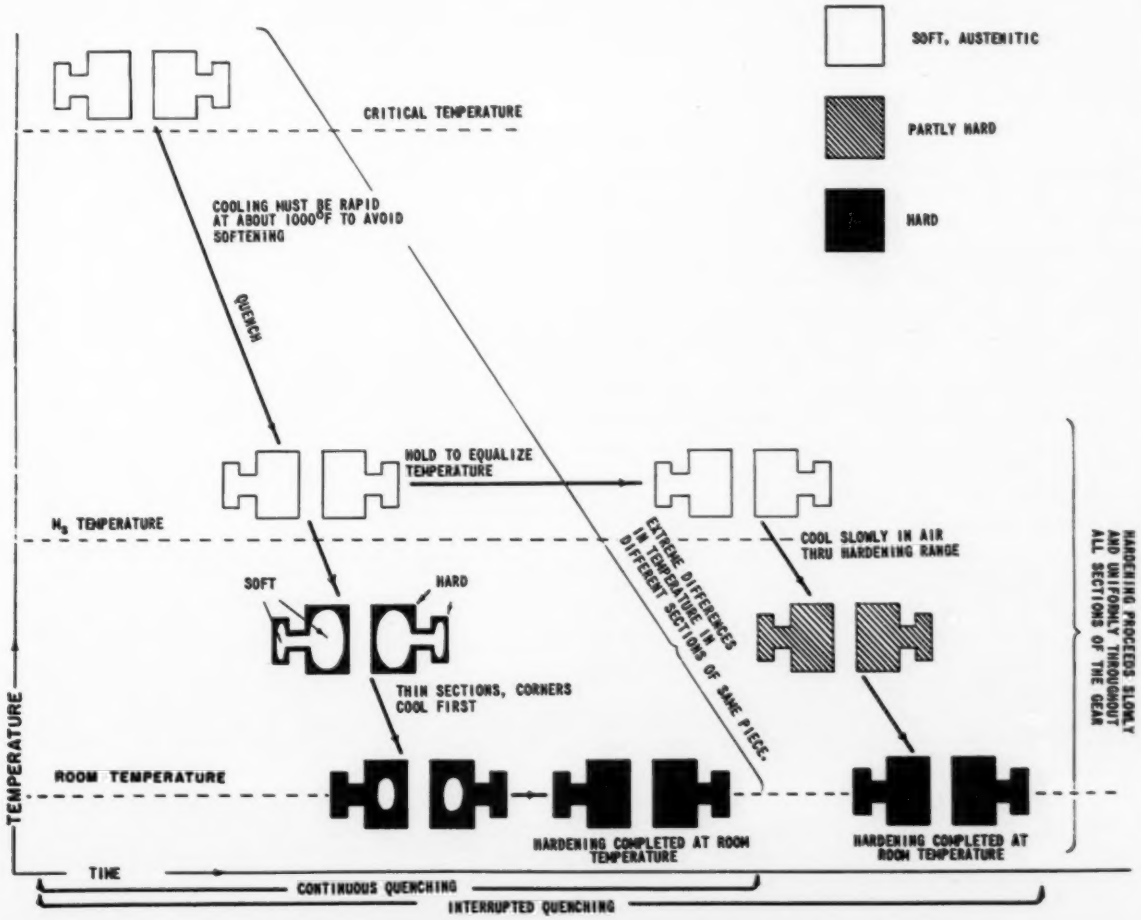

Fig. 2—Indications of structural changes which occur when parts are cooled by various methods.

ually the desired end product of hardening operations.

Alloying elements in general increase the time for the transformation to start and to be completed. Thus plain carbon steels would have curves to the left of that illustrated in Fig. 1 and more highly alloyed steels in general will transform more slowly and the transformation curves will be shifted to the right.

The hardening of steel is generally accomplished by one of the following methods (a) continuous cooling from above its critical temperature to room temperature usually in air, oil, or water; or (b) interrupted quench hardening.

While more steels are presently hardened by the first method, the second method has found greatly increased commercial acceptance in recent years.

Interrupted Quenching

With conventional quenching methods, parts of intricate design or having appreciable differences in mass may shrink, grow, distort, twist, or crack. Distortion and cracking result from the unequal distribution of stresses set up by the transformation of austenite to martensite occurring at widely different intervals of time in different sections of the part.

Cracking on hardening is a common occurrence. This illustrates the tremendous degree of internal stress which can be built up during hardening. For example, a fully hardened tool steel may have a tensile strength of 400,000 psi. If the stresses resulting from hardening are greater than the strength of the steel, it will crack in the quench. If the stresses are not quite so high but are, for instance, 75% of the total strength or 300,000 psi. then the remaining strength left to do useful work is only 100,000 psi.

With conventional quenching even symmetrically shaped parts may have a considerable concentration of stresses, the reason being that the outside or surface transforms to martensite first resulting in an expansion. The interior transforms afterwards to hard martensite and tries to expand but is resisted by the hard martensitic surface. Also simultaneously there is a thermal contraction taking place as the steel changes in temperature from the critical temperature to room temperature. Other factors such as decarburization, retained austenite etc. also have an effect. The net result of all of these factors is internal stresses which weaken the part or may even crack it.

Interrupted quench hardening, first designated "step quenching" by the writer back in 1938 when the treatment was applied to hacksaws, attempts to equalize temperature gradients within parts before martensite starts to form. In this method of hardening, which in later years has come also to be known as martempering or marquenching, parts are quenched into a hot bath at a temperature slightly within or above the range of martensite formation for the steel being hardened. The hot bath is generally molten salt or hot oil.

Parts are held in the molten bath for a period of time sufficient to bring all portions of the part to the bath temperature but for a length of time insufficient to result in any appreciable amount of transformation to the relatively softer higher temperature transformation products, and then the parts are cooled slowly in air to room temperature. Since the austenite to martensite transformation occurs practically simultaneously in all portions of the parts, concentrations of stress and warpage are minimized and cracking is avoided.

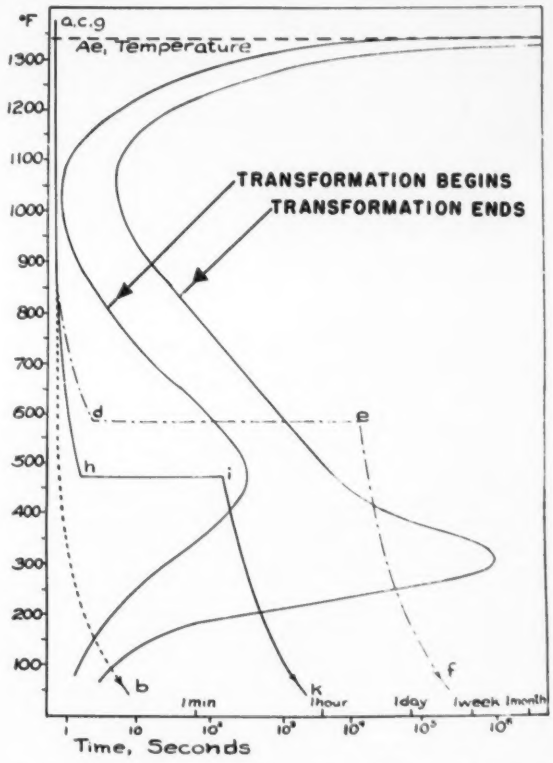

Fig. 3—Diagram showing conventional quenching (curve b), step quenching (curve k) and austempering (curve f).

To fully harden steel it is not necessary to quench rapidly all the way down to room temperature but only fast enough to avoid transformation at the nose of the S-curve where soft pearlite forms. Once the steel is cooled rapidly enough to avoid transformation at the nose of the curve (at about 1000°F. for many steels) the steel will fully harden even when cooled slowly through the range of martensite formation to room temperature.

Fig. 2 illustrates schematically the changes which occur on hardening gears by the two

(Continued on page 10)

Tool Steel Topics

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

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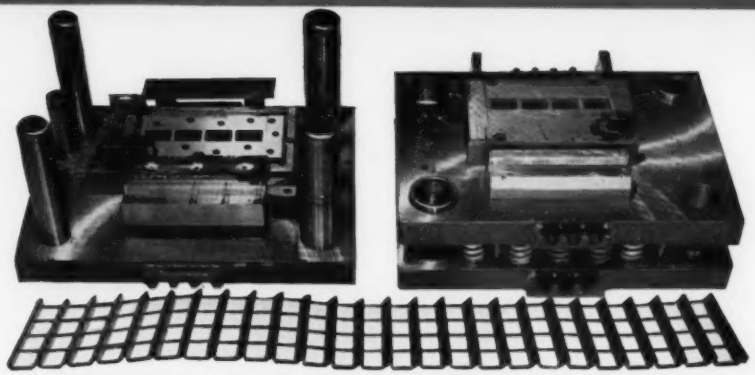


Maker of Agricultural Machinery Gets Good Results With Lehigh H

The Gleaner Harvester Corp., Independence, Mo., has every reason to be proud of its revolutionary, self-propelled combine. For this mechanical marvel, with its centerline design, is a joy to behold as it takes large, continuous bites into blowing fields of grain.

Making parts for this practically human thresher and separator calls for some highly specialized dies made from outstanding tool steels. For example, the progressive die shown here, made of Bethlehem Lehigh H tool steel, produces the combine's straw rack (foreground). Operating in a 150-ton press, the die blanks and forms 22-gage galvanized sheet steel, about 50 strokes of the press being required to make each rack. The die is subjected to more than 20,000 strokes before inspection is required — ample proof of its durability.

Lehigh H is our high-carbon, high-chromium air-hardening tool-and-die steel. It's outstanding for long production runs because of its wear-resistance and toughness. Moreover, it offers minimum distortion during heat-treatment, plus the ability to harden deeply.

Lehigh H is safe-hardening. It is cooled in still air from a hardening temperature of 1850 F, and minimizes the cracking hazards of intricate dies, thin sections, and insufficient radii.

Your tool-steel distributor will be pleased to answer your questions about Lehigh H. He's always at your service.

BETHLEHEM TOOL STEEL ENGINEER SAYS:

Carburization of Tools Can Be Detrimental

Widely known are the beneficial effects obtained by intentionally carburizing some tools during heat-treatment. In general, wear-resistance of the surface is increased, while at the same time the shock-resistance of the core is maintained. But what is frequently overlooked is that carburized cases added unintentionally can be detrimental to service life.

Laboratory study of failed tools has shown this type of trouble often happens. For example: Rivet sets, failing from brittleness after short service, were found to have a carburized case; coining dies failed by splitting, due to a deep carburized case (0.030 in.); an extrusion punch shattered, due to an excessive carburized case (0.040 in.), containing 3.34 pct carbon.

Unintentional carburized cases commonly result from heat-treatment operations where there is improper control of atmosphere, such as "inert" packing material, "neutral" atmosphere in furnace, and "neutral" salt bath. All of these, of course, are actually carburizing.

The cure for this type of trouble is simple — don't put on a carburized case. Or if you do, be sure to grind it off later. On most tools the required dimensions will not permit grinding off an excessive case. So the practical solution is proper control of the heat-treatment.

High-Speed Tool Steel Cuts 35 Teeth in Bronze Worm Gear

This tangential cutter, fitted with an insert of Bethlehem 66 High-Speed Tool Steel, is shown cutting a tooth on a bronze worm gear. The gear is 74 in. in diameter and is 3-1/16 in. deep. It has 35 teeth, having a circular pitch of 6.25 in. With its excellent red-hardness, balanced abrasion and shock-resistance, Bethlehem 66 High-Speed is an ideal steel for difficult cutting jobs.

methods—conventional and interrupted quenching. The diagram has been simplified somewhat for purposes of illustration to represent the essential differences in the two quenching methods.

It will be noted that hard martensite starts to form on cooling to the M_s temperature and continues to form as the gears cool to room temperature. The material represented is a medium carbon, alloy gear steel. On conventional, continuous quenching severe temperature gradients exist whereas on interrupted quenching the transformation to martensite occurs slowly and uniformly throughout all sections of the gear.

Fig. 3 shows schematically with reference to the transformation curves the step quench heat treatment as compared to austempering and conventional continuous quenching.

Over traditional hardening, interrupted quench hardening offers a number of important advantages: (1) less distortion, (2) less internal stress, (3) no cracking, (4) greater toughness, (5) greater strength, (6) increased fatigue life, (7) savings in man hours through elimination of unnecessary operations such as straightening and grinding, (8) less rejects, (9) higher hardness and wear life on case hardened work as the distortion on regular hardening necessitates removal of the hardest part of the case in grinding.

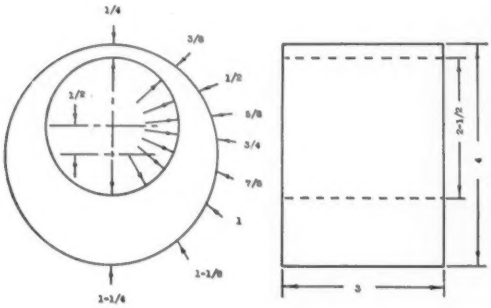


Fig. 4—Test specimen used to measure quenching power.

The hot quenching bath may be molten salt or hot oil. Hot salt has the advantage of a faster quenching rate and is more effective for large sections. Salt pumps or motor driven agitators are most effective methods of presently providing a high quenching rate for large sections. An eccentric type test specimen developed by the writer and the results obtained on hot salt quenching for conditions of severe agitation and without agitation is illustrated in Figs. 4 and 5. Both specimens of A.I.S.I. 52100 steel were heated in salt at 1550°F. for 30 minutes followed by hot salt quenching at 400°F. for five minutes.

A newly developed improvement made by the writer over conventional methods of agitation involves the introduction of sonic energy of suffi-

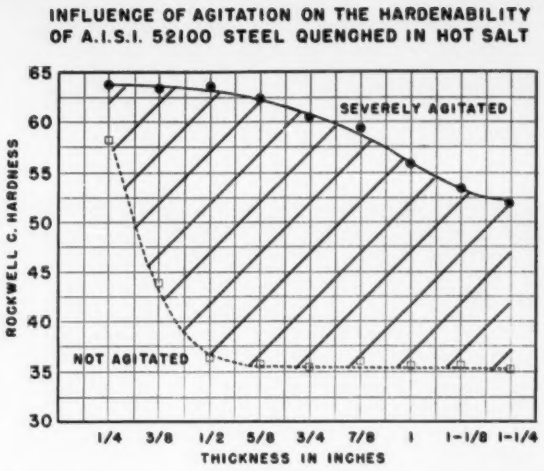


Fig. 5—Typical test results showing effects of agitation on quenching power of hot salt.

cient intensity and at high frequencies into the quenching medium to increase the turbulence and quenching effectivness. One method of introducing high frequency vibrations into the quench by means of magnetostriction transducers is illustrated by Fig. 6.

Sonic quenching is of particular value in eliminating the vapor film which forms on quenching into all liquid baths either at room temperature or at elevated temperatures. With conventional liquid quenches, the vapor film insulates the work from the quenching medium resulting in a retarded and uneven quench. The introduction of high frequency sonic vibrations into the quench results in higher quenching rates and more uniform results. This is particularly true of applications which are relatively inaccessible to the quench, such as parts with blind holes, small recesses, fine threads, etc.

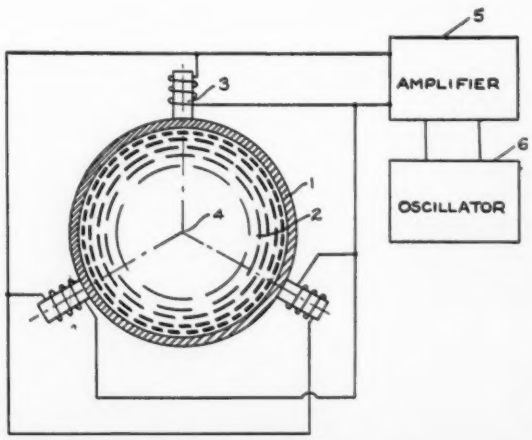


Fig. 6—Schematic diagram of magnetostriction transducer used to induce high frequency vibration in a quenching bath.

Effects of Mechanical Working

Another new modification of the interrupted quench treatment recently developed by the writer involves a combination of step quenching and mechanical working above or within the range where martensite starts to form on cooling. This is represented diagramatically in Fig. 7.

Shot peening is a common means of cold working metal parts to introduce beneficial surface compressive stress to increase fatigue life. Shot peening the metal while hot and still austenitic after removing from the low temperature bath above or slightly below the M_s point results in a greater degree of compressive stress at the surface than may be imparted by conventional cold peening methods. For example, Almen test strips 0.051 x ¾ x 3 in. shot peened to an arc height of 0.016 inches by conventional cold peening, showed an arc height of 0.029 inches when hot peened by the new method described and using the same intensity of peening. The greater curvature of the hot peened specimens has been shown to be due to a greater degree of surface compressive stress.

In addition to the higher compressive stress and fatigue life, the peening at elevated temperatures as illustrated in Fig. 7, also results in higher hardness and greater conversion of an undesirable constituent, retained austenite, from the surface. It has been found that mechanical working of the subcritical austenite results in a greater conversion to hard martensite than would result without the mechanical working. X-ray determinations of the volume percent of retained austenite on specimens peened and unpeened show a conversion of up to about 80% of the retained austenite as a result of hot peening. Other forms of mechanical working other than shot peening may be used with beneficial results. Hot hobbing of cavities in metal striking dies in accordance with the principles illustrated in Fig. 7 has resulted in longer die life. Tabulated results obtained with the step quenching–mechanical working technique are illustrated in Table I.

The trend in present day hardening is towards more extensive use of interrupted quench hardening or step quenching. On a wide variety of parts it has resulted in a minimum of distortion, cracking, and stress concentration and higher physical properties. The method is easily mechanized and can be combined with carburizing and brazing in molten salts. Commercial adoption of step quenching cuts costs, increases production, and improves quality. It has resulted in standards which were unattainable a few short years ago. ■ ■ ■

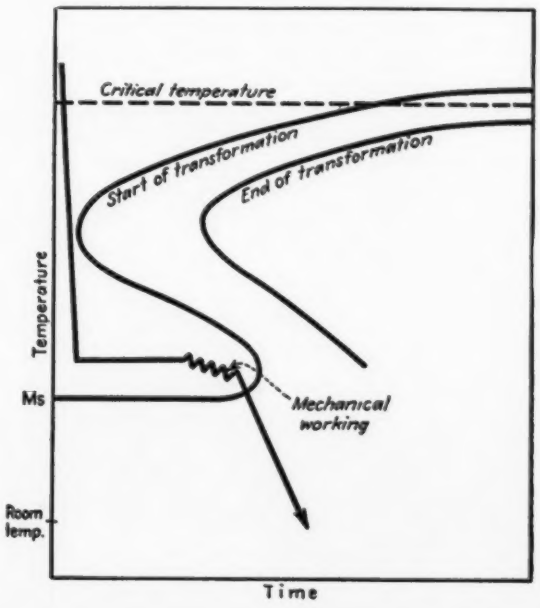


Fig. 7—Schematic diagram showing point of mechanical working in relation to structural transformation.

EFFECTS OF MODIFIED STEP QUENCHING

A

Specimen size: 0.396 x 0.396 x 3 in.			
Typical analysis, pct:	Carbon	0.95	
	Manganese	1.30	
	Tungsten	0.50	
	Chromium	0.50	
	Vanadium	0.20	
Heat treatment: 1500°F—15 min			
515°F— 5 min in molten salt			
Shot blasted immediately on one side while hot			
Intensity of peening: 0.016-in. arc height			
Hardness	Rockwell A	Equivalent Rockwell C	
Blasted side	84.4	65.9	
Other side	83.2	63.6	
Volume retained austenite, pct:*	Blasted side	12.3	
	Other side	19.1	
Austenite conversion: 6.8 pct			

B

Specimen size 0.140 x ½ x 2¼ in.			
Typical analysis, pct:	Carbon	1.04	
	Manganese	0.80	
	Chromium	1.20	
	Molybdenum	0.30	
Heat treatment: 1500°F—8 min in molten salt			
500°F—5 min in molten salt			
Shot blasted immediately on one side while hot			
Intensity of peening: 0.016-in. arc height			
Hardness	Rockwell A	Equivalent Rockwell C	
Blasted side	83.8	64.7	
Other side	82.5	62.4	
Volume retained austenite, pct:*	Blasted side	2.4	
	Other side	11.8	
Austenite conversion: 9.4 pct			

* Determinations for the volume per cent of retained austenite were conducted at the Massachusetts Institute of Technology by an X-ray method.

Table I

COMMERCIAL

HEAT TREATING SHOPS

IN FRANCE

By **BERNARD JOUSSET,**
President and General Director
Société Parisienne de Cémentation
Argenteuil, France

As a delegate to the First Metallurgical International Congress which took place at Detroit in 1951, I had the opportunity to visit several commercial heat treating shops in the U.S.A. and I was able to notice significant differences in the way they are operated as compared to France.

In the States, the commercial heat treating shops are distributed among most of the larger industrial cities over the wide territory of the Union.

The situation is quite different in France, a country which only covers an area smaller than the State of Texas and where the distribution of the industries is much less uniform. Indeed, to justify the existence of commercial heat treating shops, a geographical concentration of various sized industries is required within a comparatively restricted area in order to make possible the collection of the work to be processed.

Fig. 1—General view of author's plant.

Whilst such a set of conditions is easily fulfilled in a number of cities belonging to a nation of the pattern of the U.S.A., it only exists in France in a few towns: Paris, Lyons, Saint Etienne, Grenoble and Lille and then still with a distribution very different as to the number of the industries involved. This is shown in the following classification of the most important commercial heat treating shops that are listed according to their regional dependence:

1. Application de Traitement Thermique des Metaux ("A.T.T.M.")
   11 Avenue Jean Jaurès
   Le Pre Saint Gervais (Seine)

Fig. 2—Gas-fired furnaces for hardening and carbonitriding.

2. Sté. Francaise de Calorisation
   82 Rue Saint Lazare
   Paris (8)
3. Ets. Costerg
   68 Rue Ed. Vaillant
   Bagnolet (Seine)

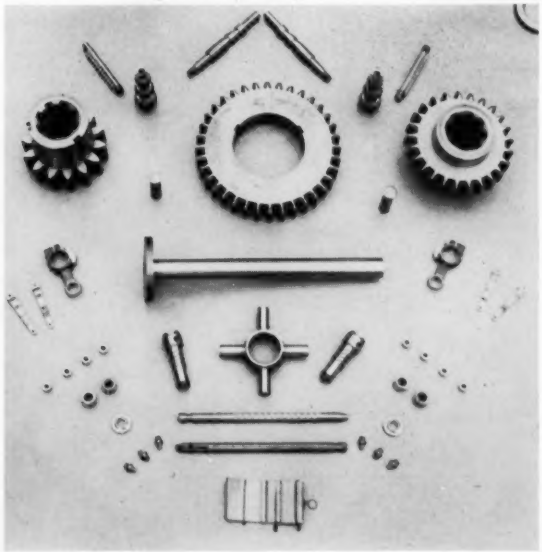
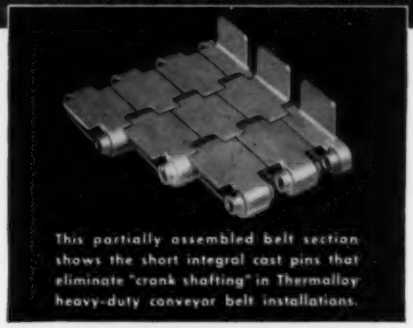


Fig. 3—Typical parts treated by carbonitriding.

(*Continued on page* 14)

THERMALLOY* APPLICATION ENGINEERING AT WORK



This partially assembled belt section shows the short integral cast pins that eliminate "crank shafting" in Thermalloy heavy-duty conveyor belt installations.

specify THERMALLOY FURNACE CONVEYOR BELTS for heavier loads at high heat

55" wide on bearing centers of 32', this new furnace conveyor belt at Commonwealth Industries, Inc., Detroit, carries over 35 lbs. per sq. ft. in normal service. At times, a total of 5,000 lbs. and more is loaded on the belt. And it's versatile! Work ranges from ½ lb. to 100 lbs. per piece, temperatures up to 1650°.

Here was the problem. Commonwealth, modern commercial heat-treater for the automotive industry, needed a belt which could carry small and large parts to be heat-treated, in volume. They asked Electro-Alloys to help. Starting with the Thermalloy heavy-duty belt design, Electro-Alloys engineers designed special side links to keep the small work from rolling off into the furnace bed. The results have been higher production at less cost for Commonwealth, and another successful case history of Thermalloy application engineering at work.

Our permanent staff of engineers is ready to help *you* design, improve or modernize the alloy in your heat-treating installations. Thermalloy heat-resistant alloys are cast for many furnace and other heat-treat applications. Write us in Elyria, Ohio, for Conveyor Belt Bulletin T-241, or call any of the sales offices listed below.

*Reg. U. S. Pat. Off.

AMERICAN Brake Shoe COMPANY

ELECTRO-ALLOYS DIVISION

6003 TAYLOR ST., ELYRIA, OHIO

Sales offices in: Los Angeles, Oakland, Chicago, Detroit, New York, Cleveland, Toledo, Philadelphia, Pittsburgh

For further information circle No. 4

4. Ateliers de la Defense
16 Avenue Perronet
Puteaux (Seine)
5. Durferrit-Sofumi
36 Avenue Hoche
Paris (8)
6. Sté. Electro-Thermique
36/42 Rue de Belfort
Courbevoie (Seine)

Fig. 4—View of small shaker hearth furnace for atmosphere treatment of small parts.

7. Forges d'Ivry
45 Boulevard du Colonel Fabien
Ivry-Port (Seine)
8. Ets. Le Keux
50 Boulevard de la Villette
Paris (19)
9. Ets. Mesager
7 Quai Marcel Boyer
Ivry (Seine)
10. Forges & Ateliers de Meudon
175 Avenue de Verdun
Meudon (S.&.O)
11. Sté. Parisienne de Cémentation
134 Quai de Bezons
Argenteuil (S.&.O)
12. Ateliers Partiot Cémentation
56 Avenue de Chatou
Rueil Malmaison (S.&.O.)
13. Ets. Rambert
29bis Rue des Orteaux
Paris (20)
14. S.I.B.E.L.E.
29 Rue de Berri
Paris (8)
15. Ets. S T U M M
3 Rue Lambrechts
Courbevoie (Seine)
16. Sté. de Traitement & De Protection des Metaux
9 Rue Pagès
Suresnes (Seine)
17. Ets. T R A U T
32 Rue des Montiboeufs
Paris (20)
18. La Trempe Moderne
115 Boulevard Saint Denis
Courbevoie (Seine)
19. Ets. Aubert & Duval
41 Rue de Villiers
Neuillys/Seine (Seine)
20. Ets. Pionchon
24 Rue de la Cité
Lyon (Rhône)
21. Ateliers du Forez
Rue de la Roche au Geai
Saint Etienne (Loire)
22. Ets. B L A N C
52 bd. Thiers
Saint Etienne
23. Ets. Paudrat & Saby
1 Rue Emile
Saint Etienne
24. Cie Lilloise des Moteurs
à Lille (Nord)
25. Ets. C A I L
Rue de Douai
Denain (Nord)
26. Ets. Lemaire
5 Rue du Trié
Onnaing (Nord)
27. Sté. Ugine Infra
14 Rue du Drad
Grenoble (Isère)

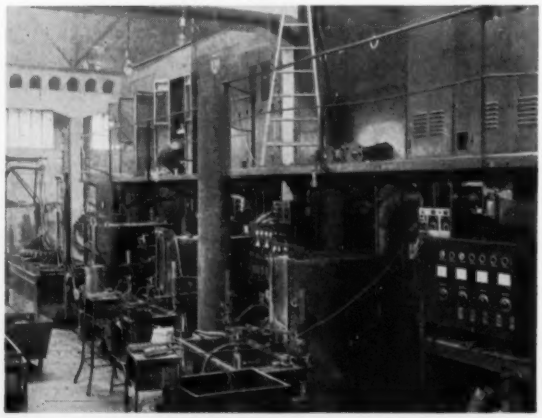


Fig. 5—View of high frequency tempering equipment in the plant of Ets. Partiot.

"Integrated" Shops

There is also in France a problem which appears to be specifically national. By this I intend to refer to the so-called "integrated" shops, that is to say the shops belonging to big works who use them for their own needs in normal times. However, during crisis periods, those firms strive to get for their shops a better capacity coefficient by securing jobbing orders from the outside at dumping prices. This is, of course, an unfair competition and is more dangerous for the firms having their only activity relying on heat treatments as for the integrated shops. No account is taken in the cost prices either of the numerous overhead charges related to the main offices or of a normal profit margin that the commercial heat treaters have to include.

It should also be mentioned that many average industrial establishments are decentralized all over the whole French territory and in their own interest, on account of their remote situation from an important center, they are compelled to run their private heat treating departments even if same has a poor performance.

We must also point out that in France a very common feeling is to make everything by one's self and to give on contract outside the fewest possible jobs. It is the opinion that the work outside will be more expensive, will require more time, and will not be so well done as in the integrated shop. No need to say that such a turn of mind is strongly supported by the companies who build and sell furnaces and heat treating equipment. This is wrong in our opinion since the bulk of the parts to be treated remains quite the same, should it be processed by the manufacturers themselves or by the commercial heat treaters. The fact is that the commercial shops because of a concentration of large facilities and a skilled labour are in a much better position to carry out satisfactorily the operations involved than many users who have no special qualifications for a technique growing more and more specialized.

It is precisely on account of the accuracy and the complexity of the methods, particularly those concerning the various operations under controlled atmosphere, that the users will realize that they should apply to a specialist. However, it is true that the apparently easy methods connected with the application of salt bath treatments, the versatility of which is obvious, to perform all heat treating operations including case hardening up to a depth of about 0.030 in., will always incite some manufacturers to operate by their own means for small amounts of parts. Nevertheless, when they have to deal with large quantities of components requiring the more elaborate treatments of carbonitriding, gas carburizing, and nitriding as well as tool treatments, they do much better to resort to the specialist.

Owing to the very limited number of commercial heat treating shops scattered over the French territory out of the Paris region we are going to study more particularly the structure of the heat treating industry in that part of the country.

A very important feature is that the great majority of motor car manufacturers have their works in Paris or the suburbs, and that by way of consequence there are also many firms in the surroundings who supply the motor car industry with components or assemblies that need to be heat treated, and as a rule that kind of firm does not own heat treating equipment.

A great number of firms are also manufacturing motor car spare parts known as "adaptable parts," that term being used in contrast to the standard spare parts sold directly by the motor car manufacturers.

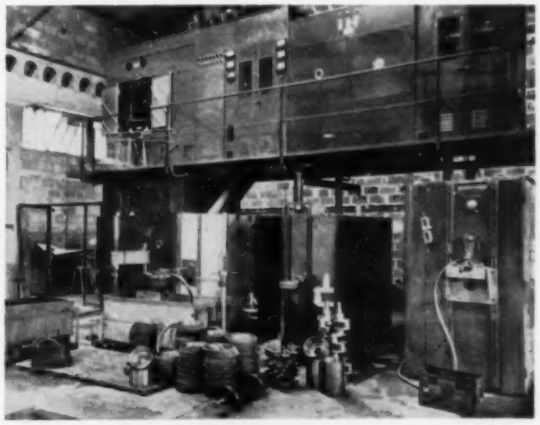


Fig. 6—Additional facilities for tempering in the plant of Ets. Partiot.

If one adds to the above mentioned firms a large number of companies manufacturing electrical and mechanical equipment and instruments of all descriptions it makes a very important industrial network including many medium or small firms that must apply to the commercial heat treaters. For some people, the heat treatments are still rather obscure and hazardous processes and a matter for fully initiated specialists.

Amongst the fifteen or so heat treating commercial shops in the Paris region, three or four are in some manner shops integrated in steel works or in forging works such as Durferrit, Forges d'Ivry, Forges & Ateliers de Meudon and Aubert & Duval. The latter has been engaged the last twenty years in the nitriding process on an exclusive basis in France. This firm presents a unique particularity in that it only agrees to treat its own steels, taking

at the same time the full responsibility as to the grade of the steel and the kind of treatment performed as well. Thus the customers do not experience any trouble in case of failure from suppliers and heat treaters declining their mutual responsibility, at the prejudice of the users.

As to the other firms devoted entirely to heat treating jobs on a commercial basis, two are maintaining from 150 to 200 men working in 3 shifts. The remaining ones are smaller firms employing only 5 to 30 people.

Generally, the equipment is of the conventional type and of a rather early design, viz. lean gas or oil heated furnaces for the larger carburizing jobs, and annealing or other operations; the temperature automatic regulation is an exception. On the other hand, salt baths, carried out either in crucibles heated by gas and/or fuel oil, or still by means of dipping electrodes remain quite common, specially in the smaller shops unable to make the necessary investments for larger installations.

New Processes

However, the two important shops we have spoken of have turned towards definite specialties or new processes.

Fig. 7—General view of the salt bath equipment in the plant of Durferrit-Sofumi.

For instance, the Etablissements Partiot were the first in France to make use of a very important equipment for high frequency hardening (several banks of 100 KW each). They are considered as pioneers in that field over here, bearing a risk, which in fact occurred, to have their most important customers purchasing a similar equipment to cut down unnecessary handlings due to the importance of their series of components to be treated.

Such a requirement is a big disadvantage for the commercial heat treating shops, since they receive now a shorter series which call for frequent tooling changes resulting into a lower productivity.

Ets. Partiot have been also leaders for the treatments to improve friction conditions between metallic surfaces. They are exclusive concessionnaires of the *SULF-INUZ* process, a treatment through sulfurizing baths.

At the Sté. Parisienne de Cémentation when the author came back from the U.S.A., notable attempts were made to take advantage of the controlled atmosphere treatments. The aim was to substitute gradually gas carburizing for the obsolete pack carburizing process which was too expensive and lacking of accuracy. Another endeavour was to introduce carbonitriding—only at its very start in France—and also special annealing treatments under cracked or dissociated ammonia atmosphere particularly for the sheets with an oriented structure used in the production of transformers and other electrical appliances. Chromizing is also in progress for some specific applications, and some development in the light alloy casting heat treatment is also taking place.

Constant Improvement

The idea is now spreading that it has become imperative to improve the quality, to shorten the times of delivery, to increase the productivity, and to lower the cost prices. Concurrently it appears also quite necessary to reach a closer precision in the treatments. In fact, the largest French companies, such as the S.N.C.F. (National French Railway Cy), which gives many contract jobs, have recently issued more exacting specifications and they perform more rigid inspections upon the goods at their delivery. They use for those purposes instruments like the Magnaflux in order to detect surface crackings in the case hardened and ground parts. Such flaws are most often invisible to the naked eye so that heat treaters are themselves compelled to perform closer inspections and to improve their standards. Treatments to closer tolerances must keep pace with the same tendency in machining and grinding.

Customers now insist upon very prompt deliveries. This can only be insured with important motor lorry services, the work being collected at the customers' workshops and delivered in finished condition within the next three or four days.

Competition has grown much more severe for some time, and the Malthusian spirit which prevailed during the post-war period under price agreement shelter is now old-fashioned.

A race to productivity has started, but a problem dealing with new equipment investments has also arisen; indeed the whole matter deals with a full reconversion or a complete renovation of most of the industrial equipment that has remained rather obsolete.

As an example, the replacement of the old lean gas-fired brick furnaces for pack carburizing by

(Continued on page 37)

Small diameter Inconel rod locks tray segments in position; eliminates structural welds and permits tray to expand and contract without undue stress. This Inconel tray is made by Misco Fabricators, Inc., 1999 Guoin St., Detroit 7.

Misco uses Inconel to triple life of gas carburizing fixtures

The tray you're looking at carries 30 pounds of odd-shaped baffles through 1650°F. . . . in a continuous furnace.

An oil quench follows . . . the entire heating and cooling cycle taking 11 hours.

At one time, fixtures were made of an alloy steel . . . and lasted only *three* months before failure from cracking and breaking.

Then Misco Fabricators, Detroit, switched to Inconel®. . . and the service life of the equipment was extended to *nine* months.

A 200 per cent improvement! But expected. For Inconel withstands severe thermal shock without spalling . . . sudden cooling without cracking. And has excellent resistance to reducing, carburizing or nitriding atmospheres.

By using Inconel fabricated equipment, the heat treater gets light, but rugged, fixtures . . . designed for his specific needs. And he gets strength and corrosion resistance at high temperatures.

So, if heat isn't treating *your* equipment well you'll probably save your disposition and money by writing for our booklet "Keep Operating Costs Down When Temperatures Go Up."

The INTERNATIONAL NICKEL COMPANY, Inc.
67 Wall Street New York 5, N.Y.

INCO Nickel Alloys

Inconel ...for long life at high temperatures

For further information circle No. 5

A Review of

SALT BATH CARBURIZING

Part I

By **E. N. CASE,** *Supervisor*
Metal Chemicals Section,
American Cyanamid Company
New York, N. Y.

Editor's Note: *It was felt that to reduce this article in length to fit one issue would be to sacrifice its value, hence this is Part I of two parts.*

This attempt to cover some of the outstanding advances in the field of liquid carburizing has posed one major problem—that of deciding which improvements to minimize or eliminate so as to fit such a discussion within a reasonable space. For this reason the discussion has been limited to practical and fundamental advances.

The American Society for Testing Materials defines carburizing as "a process of case hardening in which carbon is introduced into a solid iron-base alloy by heating above the transformation temperature range while in contact with a carbonaceous material which may be a solid, liquid or gas."

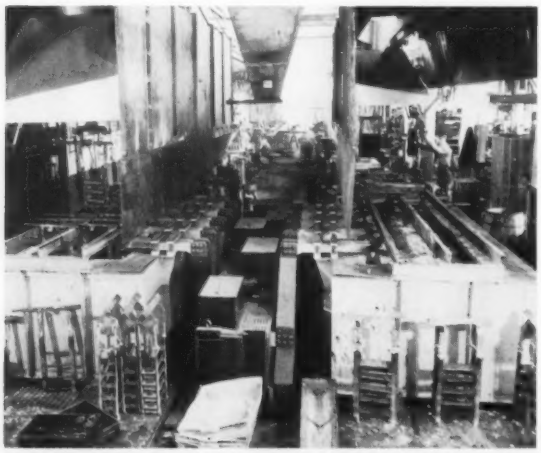


Fig. 1—Two lines of carburizing furnaces used for case hardening of bearing races. The working dimensions of the furnaces are 8 feet long, 3 feet wide, and 2½ feet deep.

The carburizing process provides a worthwhile combination of wear resistance on the surface and toughness in the core of the metal, a combination which is practically useful for a wide range of applications. Carburizing also makes it possible in commercial practice to make a steel easy to machine and give it on the surface the characteristics of a high carbon heat treated product.

Carburizing, unlike some of the other methods of surface hardening, is essentially a diffusion process involving the penetration of carbon into the surface of the metal. Other processes of hardening by surface diffusion are known. Chief among these methods is the nitriding process which can be done from a gaseous medium involving cracked ammonia but can also be carried out in salt baths containing cyanates. In this case, nitrogen rather than carbon is the material which is diffused into the metal. Other metals may also be diffused into the surface of iron to harden it or to obtain greater wear or corrosion resistance.

Carburizing can be applied to an entire range of parts from light business machine components to extra heavy armor plate for battleships. It is used on the crankshafts of a refrigerator compressor and the sheet metal screws which hold the shell of the same unit together. The few lines quoted from the ASTM definition cover a wide range of variables in commercial practice.

The definition of carburizing states that the iron may be in contact with a "sold, liquid or gas." This article will deal with liquid phase carburizing, which has very interesting industrial applications and many operating advantages.

Liquid Phase Carburizing

Molten salts permit more rapid heating than is possible by most other media, and at the same time, due to the freezing of salt in a protective layer around the work, provide an automatic pre-heating effect which considerably reduces the initial heat shock. They permit great uniformity. Thin sections do not overheat since the work obviously cannot become hotter than the salt itself and at the same time the work is heated evenly and rapidly. The salt has a buoyant effect, which tends to give additional support to the work being processed and may

account, in part, for the lower distortion which is normally experienced. The rapid heating effect means that more production can be obtained with the same floor space. It is possible to carry on two processes simultaneously, such as brazing and carburizing, thus further reducing and simplifying the equipment involved. Apparatus required for salt bath operation is generally quite simple in construction and easy to maintain, but at the same time it permits selective heating and selective carburizing by partial immersion of the parts in the bath.

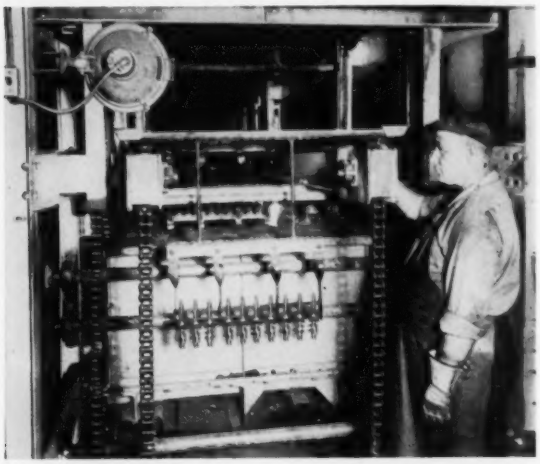


Fig. 2—Operator at the load and unload station of an Ajax mechanized line of salt bath furnaces which carburize and martemper outboard motor crank shafts.

While a salt bath installation is usually low in first cost and hence in capital expenditure, the lower distortion which is characteristic of salt bath heat treatment frequently gives lower finished costs where accurate parts are to be produced. This latter factor may completely outweigh even the savings in cost characteristic of the heat treat operation. Finally, but by no means least, clean scale-free work is produced by molten salt bath heat treatment as a matter of course.

With so many advantages it is not surprising that some disadvantages should also be characteristic of the salt bath process. One of these is the necessity of removal of the protective film of salt from the work after heat treatment or before heating in air furnaces, particularly when parts are quenched in oil rather than water. There is also the fact that salt bath operation, like all methods of heat treatment, is not always applicable to all parts. We have in fact occasionally found ourselves in a position of having to recommend other methods of heat treatment in order to produce the desired results. It is not possible to use all salt baths indiscriminately since the tempering baths, for example, should not be used to pre-heat work for hardening or carburizing.

As a general rule, water introduced into a molten salt bath turns rapidly to steam and may blow a portion of the bath out of the pot. For this reason it is necessary to have work dry when it is immersed into the furnace. Finally, all commercial carburizing baths manufactured today contain sodium cyanide which is, of course, a deadly poison. This means that adequate precautions should be taken when handling molten baths containing cyanide. Parts from such baths should never be quenched into tempering baths as an explosive reaction may occur.

Effects of Temperature

Any diffusion process is dependent for its speed of operation on the temperature involved. The process is subject to the basic law governing movement of molecules. Fick's law says that

$$\frac{dm}{dt} = -K_D A \frac{dc}{dx}$$

which is a mathematician's way of saying that the amount of carbon moving in a given time is dependent on the area, the difference in carbon between the two layers, and the distance between them. The constant K_D is a function of temperature. Without going through the mathematics involved, we can say that the case depth at any given temperature is expressed as $C = k\sqrt{t}$ where C is the case depth in inches, and t is the time at heat. k has, approximately, the following values:

0.008 for 1400°F.	0.018 for 1600°F.
0.010 for 1450°F.	0.021 for 1650°F.
0.012 for 1500°F.	0.025 for 1700°F.
0.015 for 1550°F.	0.029 for 1750°F.

Fracture case depth values will be somewhat lower. The practical effect of time and temperature on a bath which produces maximum carbon content, then, can be summed up as follows:

Time—Case depth is proportional to the square root of the time at heat; temperature being constant

Temperature—Case depth approximately doubles for a temperature rise of 200°F., for a constant time

Typical curves showing penetration rates for a commercial carburizing salt will show the marked effect of temperature on the rate of penetration. For this reason, the rapid heat-up time which is characteristic of molten salt baths greatly reduces the total time in a furnace required to obtain a given depth of case. Once the work is at temperature, the rate of penetration is limited by the diffusion laws, and *this limit cannot be exceeded.* A poor carburizing atmosphere or a poorly compounded salt bath may *reduce* the rate of penetration below the figures given but no known method short of changing the temperature has been found which will *increase* penetration rates.

For this reason operating temperatures in commercial carburizing have increased over the years in order to improve the speed of penetration. (To be concluded in next issue.) ■ ■ ■

HEAT TREATING

Takes Prominent Billing

IN TWO WEST COAST SHOWS

A.S.T.E. CONVENTION

Metal treating processes, equipment, and personnel were among the attractions that highlighted and climaxed the American Society of Tool Engineers' 1955 Western Industrial Exposition and annual convention at the Shrine Auditorium in Los Angeles this Spring.

Fig. 1—This Bendix-Pacific ultrasonic agitator aroused considerable interest at the recent ASTE exposition in Los Angeles because of its relatively large size and potential applications.

In fact, a heat treating expert was elected to succeed Joseph P. Crosby as president of the ASTE during the meeting. He is Dr. Harry B. Osborn, Jr., technical director of the Tocco Division of The Ohio Crankshaft Company at Cleveland.

Dr. Osborn and his Tocco Associates are specialists in the induction heating field, and are particularly well-known for the development of a controlled-atmosphere carburizing process which permits the production of an 0.020" case on steel in a matter of seconds.

Fig. 2—Speakers at technical session on heat treatments at recent ASTE convention (from left to right): E. W. Kempton, Jr., moderator; A. V. Luebbers, Jr., and R. H. Lundquist who presented a paper on heat treatment of steels; and Dr. George Perkins, who presented a paper on the heat treatment of aluminum.

An exhibit featuring the latter process and Tocco induction heating equipment was one of the main attractions at the exposition.

Another outstanding display was sponsored by the Lindberg-Fisher Division of Lindberg Engineering Company, Chicago. Its principal constituents included one of the latest electric resistance melting furnaces and Lindberg's new master control and heating station.

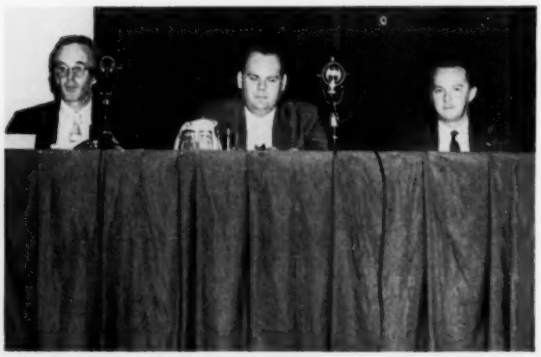
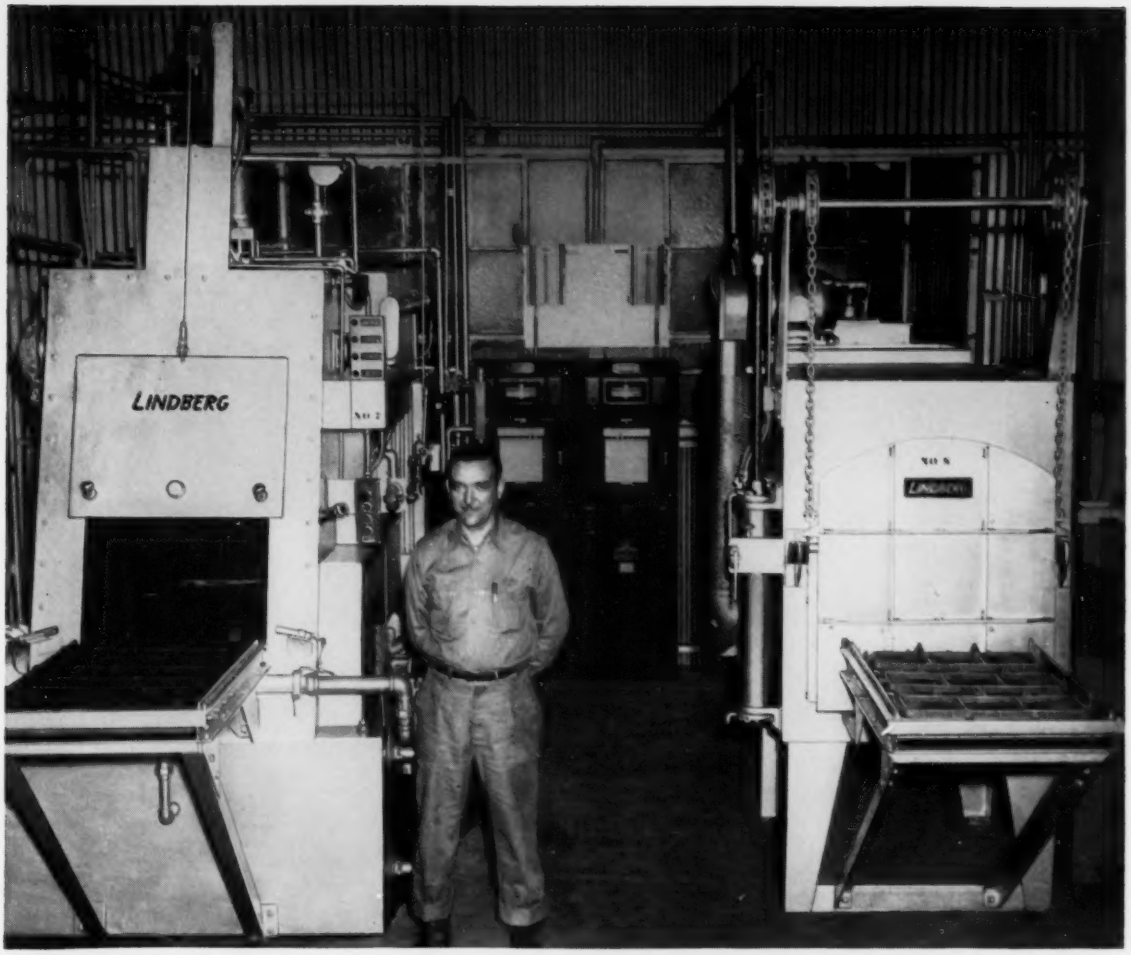


Fig. 3—Panel members who participated in technical session on heat treating at the recent ASTE convention (from left to right): Daniel F. Malloy, A. W. Bentheim, and Dr. H. B. Osborn, Jr.

(Continued on page 22)



VITAL QUALITY CONTROL PERFECTED WITH LINDBERG FURNACES

Carburization zero! Decarburization zero! Oxidation zero! Laboratory reports show that Lindberg Endothermic atmosphere generators maintain absolutely neutral atmospheres for production and tool steels run at Calmec Manufacturing Co., Los Angeles, California.

The Lindberg atmosphere generators and a number of Lindberg furnaces were installed by Calmec in a program to improve quality control. The results more than justified the installation of this new equipment.

Rejected parts and finishing operations following heat treating have both been substantially reduced. Parts which formerly required a heavy grind to remove distortion from heat treatment are now virtually free of warpage and can be assembled after only a light finishing operation. Important time savings have also been realized.

You can easily get results like this by using Lindberg atmosphere furnaces. We provide you with furnace atmosphere equilibrium curves to obtain precise carbon control on any type of steel.

Write for our Bulletin No. 241, or contact your nearest Lindberg field office for full details.

Wilbur R. Varney, Superintendent of the Heat Treating Division of Calmec Manufacturing Co., says:

"Since installing the Lindberg equipment, not one of the independent laboratory analyses we have received has deviated from carburization zero, decarburization zero, or oxidation zero. Our work ranges from such steels as 4130 to 52100. For aircraft areas, such as Los Angeles, this is a very important factor."

LINDBERG FURNACES

Lindberg Engineering Company, 2466 West Hubbard Street, Chicago 12, Illinois

For further information circle No. 6

TWO SHOWS (Cont.)

Cooperative Exhibits

Several exhibitors conducted actual production operations during the show, some of them on a teamwork basis. For example, Handy & Harmon of Los Angeles maintained a production brazing program in Booth 105 and sent the components thus assembled to Booth 414 where they were cleaned with a new Bendix-Pacific ultrasonic processing unit.

The latter unit was an item of special interest to many visitors not only because it is probably the largest ultrasonic agitator now in production, but because it might be adapted to many operations other than cleaning. For example, it could probably be used to accelerate a number of metal-treating processes. The metal-treating potentialities of ultrasound have been demonstrated by a number of researches but have heretofore been considered impractical for production purposes due to the relatively small dimensions of available ultrasonic processing equipment.

Fig. 4—This exhibit, sponsored by Sheridan Products of Inglewood, Calif., called attention to advantages that are being gained by using the Sanford Process to hard-coat aluminum components.

Variety of Exhibits

A tooling exhibit sponsored by Sheridan Products of Inglewood, Calif., called attention to the advantages that are being gained by using the Sanford Process to hard-coat aluminum components.

Oakite Products, Inc., of New York displayed a new line of metal cleaners which, among other things, should help solve many heat treaters' rust and scale removal problems.

The new Color-Glance Brinell Hardness Tester was featured in an exhibit staged by Steel City Testing Machines, Inc., of Detroit. It enables unskilled workers to conduct production hardness tests with optimum speed and accuracy; for, in place of a gauge, it has a series of three signal lights which respectively show whether a material is "Too Hard," "Too Soft," or "Within Range."

Because the commercial displays had a gross value exceeding $3,000,000, the exposition was said to have been the largest exhibit of production equipment ever shown on the West Coast.

Technical Papers

Two interesting technical papers read during the convention were respectively devoted to the heat treatment of steel and aluminum.

A. V. Luebbers, Jr., and Robert H. Lundquist authored the paper on the heat treatment of steel. Both men are metallurgists for California-Doran Heat Treating Co. at Los Angeles, Calif.

George Perkins, general director of the products and application department at Reynolds Metals Company of Louisville, Ky., prepared the treatise on heat treating aluminum.

Following the reading of each of the two papers, questions were submitted in writing by members of the audience and a panel of experts—including Daniel F. Malloy of the Los Angeles heat treating firm which bears his name, Arthur W. Bentheim of Lindberg Steel Treating Service at Los Angeles (both members of the Metal Treating Institute) and the ASTE's new president Dr. H. B. Osborn, Jr.

THE WESTERN METAL SHOW

Heat treating was a topic that also received unprecedented attention when the ninth annual Western Metal Congress and Exposition were recently staged in Los Angeles, California.

The two events were sponsored by the American Society for Metals with the cooperation of 24 other technical and engineering groups—including the American Electroplaters' Society, American Foundrymen's Society, American Welding Society, Industrial Heating Equipment Association, Society for Nondestructive Testing, American Society of Heating and Air Conditioning Engineers, and Pacific Coast Gas Association.

Papers on Heat Treating

Two sessions—namely, those staged by IHEA—were devoted exclusively to heat treating. However, the subject was emphasized in papers read at 12 additional sessions.

For example, during an ASM session on titanium, R. I. Jaffe of Battelle Memorial Institute at Columbus, Ohio, asserted: "The major attention of physical metallurgists now is being placed upon the kinetics of the processes through which titanium alloys attain equilibrium. . . . Alpha-beta and beta titanium alloys are exceedingly complex with respect to their response to mechanical working and heat treatment, but major progress is being made toward understanding their behavior. . . . Improved alloys and heat treatments have been

(*Continued on page* 24)

Typical Displays devoted to

HEAT TREATING

at the Western Metal Exposition

developed. The ductility and heat treatment response of alpha-beta alloys are sensitive to structure, the optimum results being obtained with the fine-grained equiaxed structure. The loss of ductility of these alloys in the acicular condition is attributed to the acicular structure acting as an internal notch."

New Developments in Titanium

Also during the titanium session, Walter L. Finlay, V.P., Mgr. of Research, of Rem-Cru Titanium, Inc., at Midland, Pa., pointed out that the basic reason for the existence of structural titanium is its strength-weight advantage, and to keep the industry expanding new properties like higher stiffness and ductile weldability must be combined with present top strength levels and considerably higher strength-weight ratios must be attained.

To help realize these needs, Rem-Cru Titanium and others are regularly producing grades of titanium which offer useful combinations of properties. One of these is grade C 130 AM, composed of (4-6) Al-4 Mn having the major features of medium strength and being heat treatable to high strength. This C 130 AM Ti-Al-base alloy features the balanced alpha-beta concept of strengthening the alpha with aluminum and the beta with a beta stabilizer like manganese, vanadium and/or molybdenum.

The heat treatment sequence for C 130 AM, 4 Al-4 Mn as shown in Fig. 1 is as follows: 2 hours at 1450-1550°F; water or oil quench; 1-8 hours at 900-1000°F. Figure 1 shows the excellent notched and unnotched fatigue strengths obtained on heat treated C 130 AM. With a notch stress concentration factor of 3.9, heat treated C 130 AM gave the quite creditable endurance limit of 45,000 psi, 26.2% of the unnotched tensile ultimate.

C 130 AM can be heat treated to very high strength levels. The higher the strength, of course, the lower the ductility and this sharply limits the probable usefulness of present titanium-base alloys heat treated to the 180,000 and 200,000 *minimum* ultimate tensile strength levels.

Metals for Petroleum Industry

In an ASM session on new metals for the petroleum industry, C. L. Clark of Timken Roller Bearing Company at Canton, Ohio pointed out: "While increased strength is required in oil and gas well tubing, there is a desire to hold the hardness as low as possible to avoid stress-corrosion cracking in certain applications and to maintain as high a level of ductility as can be done. It is obvious that these two requirements directly oppose one another and thus a compromise must be reached between strength, hardness, and ductility. . . . For yield strengths in excess of 80,000 psi, heat treatment is required such as normalizing or air cooling. An alloy should be selected which, for the given section size, will undergo complete transformation. Likewise, it is generally true that the best combination of strength and ductility for a given hardness level is a function of the tempering temperature. Thus, the higher the temperature, the better the ductility."

Speaking at the same session, E. F. Green of Axelson Manufacturing Company at Los Angeles said: "Hardenable Ni-Resist cast iron and ductile iron pump liners are on test in the oil fields. Carbide valve seats and balls are finding increasing usage, because of high corrosion and abrasion resistance. . . . Electroless nickel plating is being tested on pump fittings for resistance to hydrogen sulphide and salt water corrosion. . . . H steels are beginning to be used for high-strength sucker rods."

High-Strength Steels

In an ASM session on high-strength steels, James W. Huffman of North American Aviation, Inc., at Inglewood, Calif., reported: "Delayed failure has occurred principally in cadmium plated steel bolts and studs heat treated to Rc 40 or higher. Typically a bolt fails spontaneously by fracturing in the head or thread after torquing up and before external load is applied. Early, parts were generally pickled before plating and were not given a hydrogen relief bake. Later, parts were baked at 375° F. for three hours, although tests showed that this treatment given to cadmium plated parts did not always prevent failure. More recently, the following preventive measures were instituted: prohibition of pickling and cathodic cleaning, stress relief following grinding, use of a fluorborate cadmium plating solution, and prolonged baking. . . . An amount of hydrogen too small to affect reduction of area or notch strength may cause delayed failure. Cadmium plating introduces very small amounts of hydrogen compared with cathodic pickling or cleaning, but retards baking relief. Stressing hydrogenated parts appears to cause some type of permanent damage which is reflected in lower notch strength. Limited tests indicate that some sort of deformation or 'creep' precedes delayed failure. . . . A program now under way to determine how to prevent delayed failure will determine the amount of hydrogen necessary to cause failure and investigate sources of hydrogen, methods of hydrogen removal, and the effects of processing factors such as heat treatment and fabrication."

IHEA Sessions

During the first of the IHEA sessions, both of

(Continued on page 29)

Why another plant converted to "HOT RODS" 100%

J. Bishop & Company Platinum Works reports CRYSTOLON* heating elements outlast others by 3-to-1 in Drever furnaces

CRYSTOLON Heating Elements, or "Hot Rods", are a typical Norton Rx — an expertly engineered refractory prescription for greater efficiency and economy in electric furnace and kiln operation. Made of self-bonded silicon carbide, each rod has a central hot zone and cold ends. Aluminum-sprayed tips and metal-impregnated ends minimize resistance and power loss. Available in standard sizes and interchangeable with your present rods.

One of the Three Drever Electric Furnaces at the Frazer, Pa., tube mill of J. Bishop & Company Platinum Works, specialists in small diameter stainless steel tubing (.008" to 1" O.D.), tubular fabricated parts, surgical instruments and refiners of precious metals.

Wherever it uses silicon carbide heating elements — as in its Drever electric furnaces — J. Bishop & Company has changed over completely to "Hot Rods."

The reason: other elements lasted only 6 months — *"Hot Rods" averaged 18 months' service life!*

More and more, this 3-to-1 longer life of Norton CRYSTOLON elements is becoming recognized for the truly sensational performance that it is — and a constantly growing number of economy-minded electric furnace operators are taking advantage of it.

But there's a good deal more to this benefit-story. The longer life of "Hot Rods" means you save on element costs — because you use less of them. Also, fewer changes of elements and voltage taps mean greatly reduced maintenance, and a much smoother production flow.

Get Further Facts

on how "Hot Rods" can improve and economize your own electric furnace or kiln operations. Send for the big illustrated booklet, "Norton Heating Elements." NORTON COMPANY, Refractories Division, 624 New Bond Street, Worcester 6, Mass.

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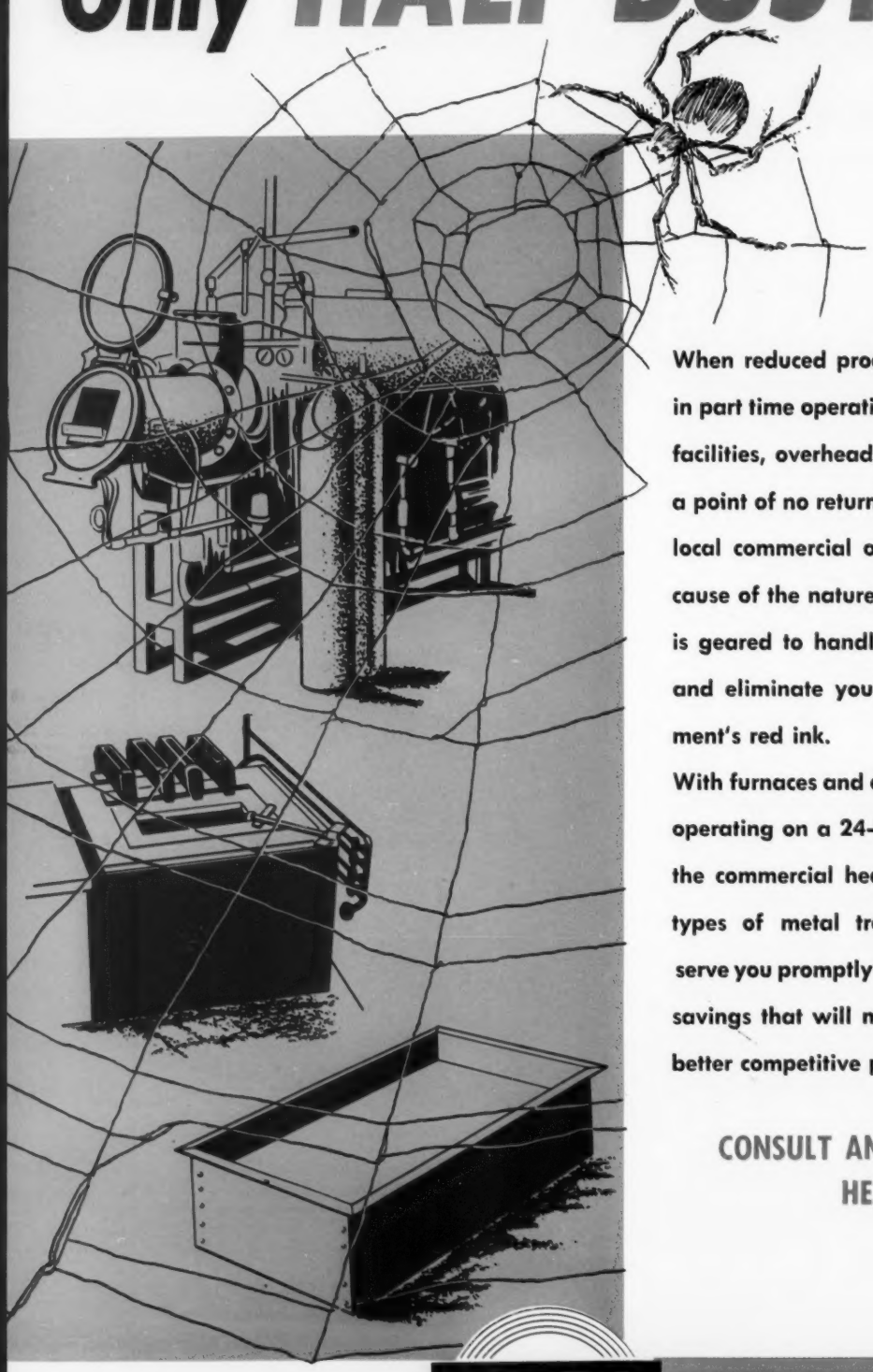

When reduced production schedules result in part time operation of your heat treating facilities, overhead burden rapidly rises to a point of no return. Chances are there is a local commercial organization which, because of the nature of his service business, is geared to handle your reduced volume and eliminate your heat treating department's red ink.

With furnaces and other equipment usually operating on a 24-hour day-by-day basis, the commercial heat treater, skilled in all types of metal treating operations, can serve you promptly and efficiently, with cost savings that will mean more profit and a better competitive position in your market.

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1536-40 West Pierce Street, Milwaukee 4
Metal Treating, Inc.
720 South 16th St., Milwaukee 4
Supreme Metal Treating Co.
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Thurner Heat Treating Co.
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Wesley Heat Treating Co.
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PART

Products are aircraft landing gear steel components, including forgings, arc and flash welded assemblies, basically tubular with complex lugs.

PROBLEMS

1. Eliminate decarburization and scaling.
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3. Reduce residual stresses resulting from heat treatments.

SOLUTION

Using an immersed electrode-type furnace 96" deep, these complex parts were austenitized in Park Chemical's Nu-Sal neutral salt at 1550°F. for 45 minutes. Previous method used 1½ hours. Quench at 400°F. is in Park Chemical's Thermo Quench Salt. Steels used are AMS 6324, AMS 6415 and AMS 6427.

Salt baths offer tremendous advantages over conventional heat treating methods. As much as 80% of all heat treating can be done in salt. Speedy handling and small floor space cuts costs. Quality is increased by eliminating quench cracks, scaling and decarb, while improving toughness and ductility.

Sixth in a series of advertisements describing Park processes on the job

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For further information circle No. 9

WESTERN METAL SHOW (Cont.)

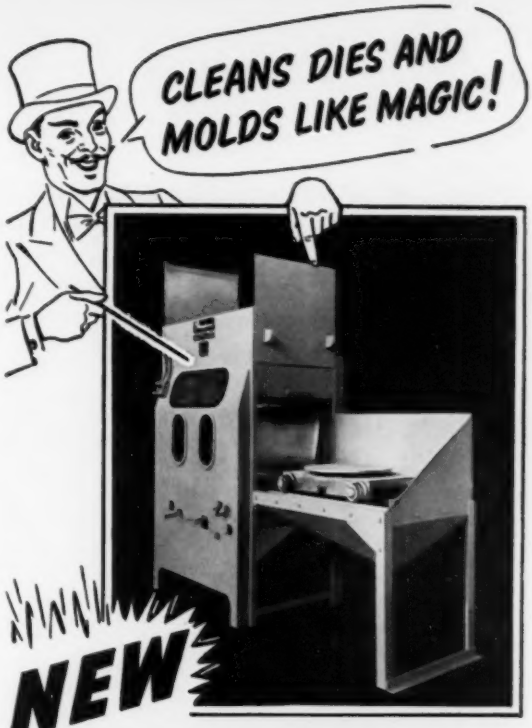
which were held under ASM auspices, D. W. Pettigrew of Swindell-Dressler Corporation at Pittsburgh read a paper on the heat treatment of nonferrous alloys; Foster Rucker of Leeds & Northrup Company at Philadelphia discussed furnaces for annealing and billet heating applications; Bernard P. Planner of A. F. Holden Company at Detroit described salt bath furnaces for the heat treatment of aluminum; B. E. McArthur of Magnethermic Corporation at Youngstown, Ohio, told how billets are induction heated; and Horace Drever of Drever Company at Philadelphia talked about the bright heat treatment of stainless steel and problems involved in heat treating titanium.

In the second IHEA session, Carl L. Ipsen of Ipsen Industries at Rockford, Ill., discussed atmosphere furnaces; Leon B. Rosseau of Ajax Electric Company at Philadelphia read a paper on salt baths; Arthur B. Wilcox of Eclipse Fuel Engineering Company at Rockford, Ill., talked about gas combustion theory and equipment; Dr. H. B. Osborn of the Tocco Division of Ohio Crankshaft Company at Cleveland described hardening and brazing applications for induction heating equipment; and Carl P. Bernhardt of Westinghouse Electric Corporation at Baltimore told how induction heating facilitates forging operations.

Metal treating processes and equipment were featured in approximately 50 of the 365 displays which were seen by spectators at the Exposition.

■ ■ ■

"I TOLD YOU NOT TO RAM IT BACK TOO FAR!— THERE'S A METAL TREATING OUTFIT NEXT DOOR!"



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For further details on Hydro-Finish, send for Bulletin 1402 now! Write PANGBORN CORP., 3600 Pangborn Blvd., Hagerstown, Maryland. ***Manufacturers of Blast Cleaning and Dust Control Equipment.***

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BLAST CLEANS CHEAPER

For further information circle No. 51

NEWS TO HEAT TREATERS...

Combination Thermocouple and Temperature Tester

A self-contained, combination tester has been added to the line of instruments and controls offered by Robertshaw-Fulton Controls Company.

The new tester is designed for convenient checking of the millivoltage output of thermocouples in both open and closed circuits, from 0-50 and 0-1000. It is suited for testing either single thermocouples or multiple thermocouple installations.

It will also accurately check temperatures, within the range from "room" up to 650°F., of water heaters, ovens, dryers, *heat treating installations,* and other commercial appliances.

The tester will automatically compensate for changes in ambient temperature, a company announcement said. Replaceable calibrated thermocouples are also available at moderate cost. Binding posts on the instrument are color-coded to prevent errors in connecting lead wires. A special vinyl meter front and larger meter pointer insure easier reading.

The price of the new instrument ($28.50, F. O. B. Youngwood, Pa.) is said to represent only Robertshaw's own cost. Its packed weight is approximately 3 lbs 3 ozs.

For further information circle No. 52

Annealing Furnace

Fifty percent greater production capacity has been obtained through addition of a new continuous annealing furnace at the New Brunswick, N.J., plant of The Carpenter Steel Company's

(Continued on page 31)

Hartz Honored for 42 Years Service

John L. Hartz, chief metallurgist for the Parish Pressed Steel Division of Dana Corporation, was recently awarded a memorial plaque by H. B. Bartlett, vice-president and general manager, in honor of his record of 42 years with the company without even a single day's absence due to illness.

One of the true old-timers in the profession of metallurgy, Mr. Hartz started work for Parish in 1911, coming from E & G Brook Iron Company of Birdsboro, Pa. Once also associated with Denison K. Bullens, he did extensive research for that gentleman's book, "Steel and its Heat Treatment," first published in 1916.

In 1918, to better keep up with rapid developments that took place in metallurgy during those years, Mr. Hartz took a specialized course under Professors Albert Sauveur and H. M. Boylston of Harvard University.

An interested observer at the presentation was Howard S. Lewis, retired president of Parish Pressed Steel Company, himself one of the earliest members of the Lehigh Chapter, American Society for Steel Treating, predecessor of the American Society for Metals, of which Mr. Hartz is also a long-time member.

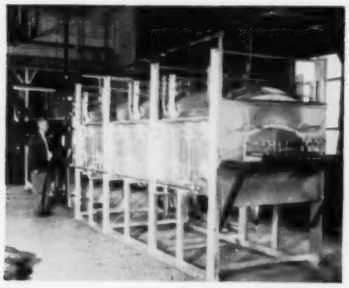
Parish Pressed Steel Division is one of 10 plants comprising Dana Corporation, a 50-year veteran of the automotive parts industry. Specialties of the Parish Division are automobile frames, heat-treated truck frames, and stampings.

John L. Hartz, recipient of plaque, at left; Howard S. Lewis, retired Parish president, center; and H. B. Bartlett, Dana Corporation vice-president and general manager of the Parish Pressed Steel Division, at right.

Webb Wire Division.

The furnace operates at temperatures up to 2100°F, and features a nitrogen-hydrogen controlled atmosphere for the brightest possible finish. Webb reports that the new facility permits uniform annealing to a predetermined tensile strength.

Wire is drawn automatically through atmosphere-filled tubes by a custom made take-up frame.



This frame, which works at varying speeds, keeps constant tension on the wire as it passes through the furnace.

The new furnace handles wire ranging in size from .032" to .162" in diameter. It is housed in a specially built extension to the plant.

For further information circle No. 10

Fire Brick

A new line of S. M. refractory fire brick has been introduced

ROLOCK

FABRICATED ALLOYS

HEAT AND CORROSION RESISTANT

FEATURES OF THE ROLOCK NEU-POT

WROUGHT ALLOY, strong, dense, uniform . . . gives thinner sections more rapid heat transfer, less hot spots, faster heat recovery.

●

ALLOY WELDS X-ray inspected . . . free from slag, air pockets, cracks. No premature failures due to these causes.

●

HEADS of fabricated pots stocked in standard diameter . . . wide range of depths quickly made without special patterns, tools.

HERE'S TERRIFIC SERVICE . . .

8000 Hours . . SO FAR . . with Neutral Salts!

Yes . . . that's really phenomenal cost saving . . . but Rolock customers expect and get more than normal use from our fabricated-welded heat treating equipment.

In this instance, it's a fabricated Inconel pot . . . ¼" plate . . . which withstands a 1550° F. operating temperature for 16 hours per day . . . stands idle for 8 hours . . . then over Sunday at about 1300° F. So far its life totals 18 months. This is probably a record, but many other Rolock neutral salt pots have served for 12, 14, 15 and 16 months . . . up to 5000 hours. Naturally, higher temperatures reduce service life.

If you require neutral salt pots of this type (any size), you will want specifications and quotations that will clearly show cost-cutting. Write for complete details of this up-to-the-minute equipment . . . or any other type of fabricated heat and corrosion resistant alloys.

SALES AND SERVICE REPRESENTATIVES FROM COAST TO COAST

ROLOCK INC., 1232 KINGS HIGHWAY, FAIRFIELD, CONN.

JOB-ENGINEERED for better work
Easier Operation, Lower Cost

IRLSS

For further information circle No. 11

Heat and Corrosion Equipment

Processing Equipment

• ALLOY •
ENGINEERED FABRICATION

HEAT RESISTING ALLOY

• Design
• Development
• Fabrication

BOXES • FIXTURES
RETORTS • HOODS
BASKETS • TRAYS
MUFFLES

MISCO EXPERIENCE IS YOUR INSURANCE

MISCO FABRICATORS, INC.
Designers, Builders, Fabricators of Heat Resisting Alloy and Stainless Steel Equipment
1999 GUOIN STREET • DETROIT 7, MICHIGAN
TELEPHONE LORAIN 7-1545
In Canada it's Misco Fabricators of Canada, Ltd.
Welland, Ontario

For further information circle No. 12

by the Robinson Clay Product Co., of Akron, Ohio. Three heat-duty classes are available: Flintex S. M. for super-duty, Robinson S. M. for high-heat-duty, and W. W. Co. S. M for low-heat-duty.

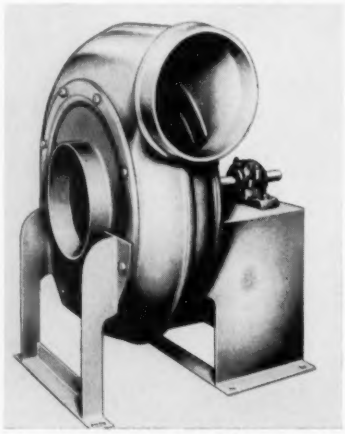
Made of selected and tested clay and manufactured by a de-aired, extruded, and repressed process, S. M. fire brick are reported high in strength and low in porosity to resist acid, slag, and abrasive conditions.

Flintex S. M. super-duty fire brick can be specified for furnace linings of all types. Robinson S. M. has exceptional physical strength in the high-heat-duty temperature ranges. For low-heat-duty applications, W. W. Co. S. M. shows high performance and durability and is said to be an ideal choice for a back-up brick in all types of industrial furnaces.

For further information circle No. 13

Industrial Fans

Cast iron fans for industrial applications are available from the Sturtevant Division of the Westinghouse Electric Corporation. This completely redesigned line of fans will handle wood shavings, chips, granular material, textile fibers, asbestos, rags, powders, dust, gases and fumes.



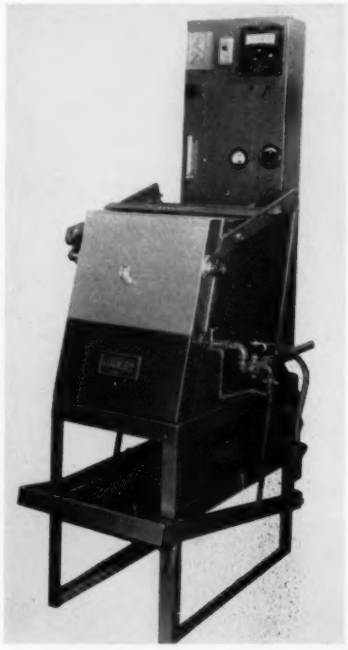
For specific applications, any of four different wheels or three drive arrangements may be selected. Protective accessories and coatings are available for high temperature and extreme abrasion installations.

This 500 series of fans features a wide range of sizes with wheel diameters from 8¼ to 34½ inches and inlet pipe sizes from 4½ to 18 inches. Air volumes range from 150 to 12,000 cubic feet per minute.

For further information circle No. 14

Tool Steel Furnace

Cooley Electric Manufacturing Corp., Indianapolis, Ind., has announced a general purpose heat treating furnace designed to use a newly-developed protective atmosphere for general hardening of tool steels. According to the manufacturer, steel hardened in this equipment is clean and free from decarburization.



The atmosphere system consists of a cracking unit to which is fed, by means of a variable speed pump, a mixture of alcohol and water proportioned according to the type of treatment disired. This mixture is cracked into gas of an analysis reported to maintain the correct carbon potential for equilibrium with the steel being treated. To insure

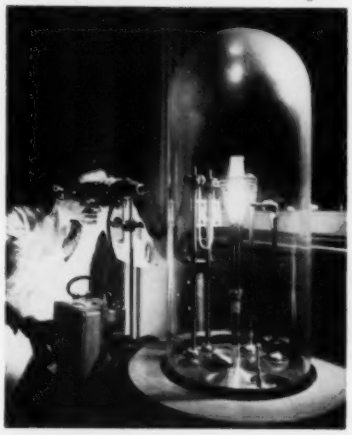
a complete seal, the furnace is equipped with an Inconel retort which has a welded thermocouple well and a welded pipe extension to provide for gas admission. The door is tightly sealed against the retort face. The chamber dimensions are 8" x 6" x 14" and the power rating is 4.8 KW at 230 volts.

For further information circle No. 15

Titanium Purification

Scientists at the Westinghouse Research Laboratories are purifying titanium and other hard-to-get metals by imprisoning the molten metal inside a cage of its own making. The process, called cage zone refining, uses a unique method to melt a bar of metal while the metal acts as its own crucible, thus preventing contamination by any containing vessel. Object of the process is to prepare super-pure metals.

The success of zone refining depends upon the fact that most impurities in metals have a preference for either the liquid or solid state of the metal. Iron, a common impurity in titanium, has a preference for the liquid



state of titanium. When a bar of impure titanium is melted progressively from end to end, the iron concentrates in the liquid titanium and follows the molten zone to the end of the bar. This end is then cut off and discarded, leaving the rest of the titanium bar more pure. Each time the process is repeated, more impurities are removed.

Commenting on the significance of the new development, Dr. Clarence Zener, associate director of the Research Laboratories and manager of the metallurgy department, declared, "the metallurgy of many important metals such as titanium is still in its infancy. Much basic research on these pure metals is needed before we can begin to realize their potential applications. We hope this new refining method will enable us to speed such research by providing increased quantities of those metals which are especialy difficult to prepare in a highly-purified state."

For further information circle No. 16

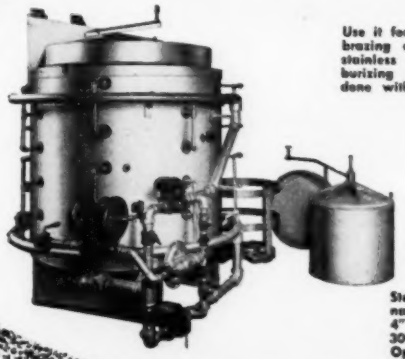
West Coast Representative

The Gas Machinery Company, Cleveland, Ohio, has announced the appointment of Heat and Control, Inc., as its representa-

WIDE RANGE WORK WITH AGF BELL RETORT FURNACES

Complete flexibility in operating temperature processing atmosphere permits an AGF Bell Retort Furnace to Nitride one charge and then to Copper Braze stainless parts in the charge immediately following.

Semi-continuous operation is achieved by the use of multiple bell retorts for independent work charges. One bell retort containing work can be cooled under atmosphere protection, while another is being loaded.



Use it for copper brazing, Nicro-brazing or bright annealing of stainless parts. Nitriding, Carburizing and Ni-Carbing also done without modification.

Standard Bell Retort Furnace sizes available from 4" dia. x 8" height up to 30" dia. x 48" height. Operating temp. up to 2150° F.

Write today for further information or send sample parts for processing at no obligation.

Pioneer Furnace Builders Since 1878.
Representatives in principal cities.
Send your catalog 606

NAME ..... TITLE .....

COMPANY .....

ADDRESS .....

AMERICAN GAS FURNACE CO.
808 LAFAYETTE STREET — ELIZABETH 4, N. J.
"Pioneers since 1878"

For further information circle No. 17

tive on the west coast for the firm's Industrial Furnace Division.

Charles A. Blesch, shown here, is General Manager of Heat and Control, Inc., with headquarters

in San Francisco, where the company's main engineering, sales, service, and warehouse facilities are located. The sales and engineering staff is comprised of James C. Harris, Jr., Clark K. Benson, Andy A. Caridis, Norman O. Schwien and Don G. Pedrotti, all registered professional engineers.

For further information circle No. 18

Industrial Heating Equipment Industry Booms

Business in the industrial heating equipment field has taken a very decided upswing in the past several months.

"Possibly one of many reasons business has been good is that executives of companies which use industrial heating in their operations were alarmed by the tense international situation and decided to order equipment to modernize their operations before it might become hard to get," Carl L. Ipsen, Executive Vice President of the Industrial Heating Equipment Association, said.

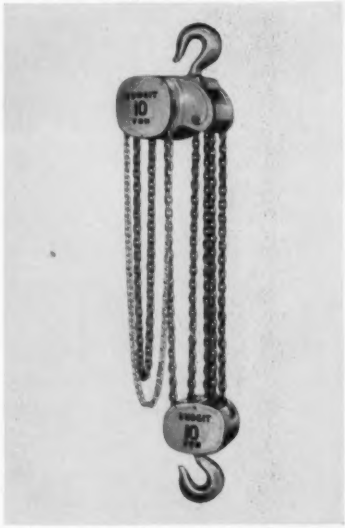
"Business has shown a consistent upward trend for the last three months for which we have figures. January and February of 1955, combined with December of 1954 show an average increase of 78% over a comparable period a year ago.

"Perhaps the basic reason is just that people want to take advantage of new developments in industrial heating equipment with their cost-cutting and labor-saving advantages."

For further information circle No. 19

Aluminum Chain Blocks

Shaw-Box Crane & Hoist Division of Manning, Maxwell & Moore, Inc., of Muskegon, Michigan has just announced the marketing of a line of lightweight, highly portable aluminum chain blocks. Known as the 'Budgit' "Hi-Cap" Aluminum Chain Blocks, they are available in 3, 4, 5, 6, 8 and 10 ton capacities and were developed especially for rugged service where low headroom, portability and ease of operation is required.

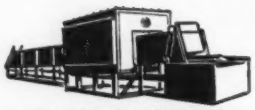


Among their construction features reported are frame and covers made from a tough shock-resisting aluminum alloy, upper hook suspension arm cast integrally with frame, splined connections, alloy steel heat treated gearing and shafts, supported on free running anti-friction bear-

AN OFFER OF HELP WITH YOUR HEAT PROCESSING PROBLEMS—

BOX

BELL



CONTINUOUS MESH BELT CONVEYOR

The men of Harper believe in and work on this principle,—you get the best results at lowest cost with high temperature electric furnaces specially designed and built to fit your products.

Isn't that better than trying to adapt your work to the furnaces? We call it "The Harper Way" and it works!

You need feel no hesitancy in leaning on Harper specialized *but broad* experience in developing electric furnaces for processing today's new metals and alloys, —with or without special atmospheres.

Your request for a discussion is bound to spark-plug some worthwhile sharing of up-to-date thinking.

Representatives in Principal Cities

HARPER Electric Furnace Corp.

51 RIVER ST., BUFFALO 2, N. Y.

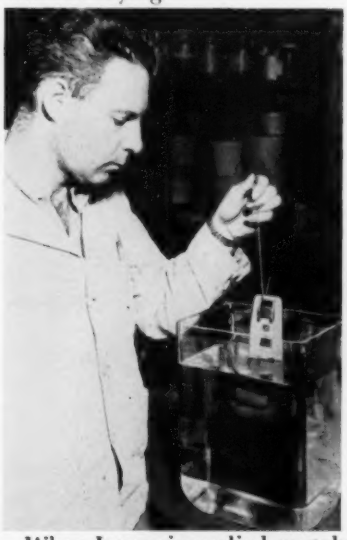
For further information circle No. 20

ings, "equa-torque" gear design distributes load on two sets of gear teeth, "full-jeweled" load brake, true vertical reeving, upper hook one size larger than lower hook and both hooks of the non-fracturing type that slowly open under extreme overloads and a non-gagging four pocket lift wheel totally enclosed by a floating chain guide which permits operating hoist in any position.

For further information circle No. 21

Metal Coating

Fidelity Chemical Products Corp. announces the availability of Laqua, a new coating for metals that preserves chemically-cleaned surfaces obtained directly after a chemical cleaning operation. Laqua can be sprayed on a clean surface or be applied as a dip after a final water rinse without drying.



When Laqua is applied, metals that normally discolor by oxidation, contact with sulphur fumes and humidity, are kept in a bright, clean condition. It also offers salt spray resistance. After 210 hours of an A.S.T.M. salt spray test, no corrosion was found on Laqua coated parts.

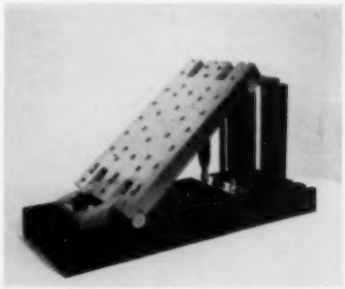
It offers the same electrical resistance as an oxide film formed on aluminum in eight hours at room temperature. This resistence remains constant with aging. A Laqua film of .0001 inch has an electrical resistance of .2 ohms at 1½ volts and does not interfere with electrical connections, wiring, or parts attached to a chassis that must remain in electrical contact. Parts can be stripped of Laqua with any strong alkaline stripper or cleaner. The approximate coverage per thinned gallon is 800 square feet.

For further information circle No. 22

Sine Plate

A new sine plate for rugged use in machining operations that incorporate large size, low initial cost and quick set up with maximum rigidity has recently been introduced by Denco Machine Products.

The plate is cast of stable, high-strength, shock-absorbing Meehanite metal and ground to close tolerance for parallelism between the top surface and the centerline of the hardened and ground steel rolls. The use of a single plate with an unusual combination pivot bearing and



clamp cuts weight and production costs in half and allows the rolls to be clamped direct to the table of a machine tool. Plates are drilled and tapped on the top surface for convenience in bolting a vise or fixture in place and are supplied complete with pivot clamp, two screw type lifting jacks and two gooseneck dog clamps. They are manufactured in three sizes, 12" x 8"; 15" x 10"; and 20" x 13".

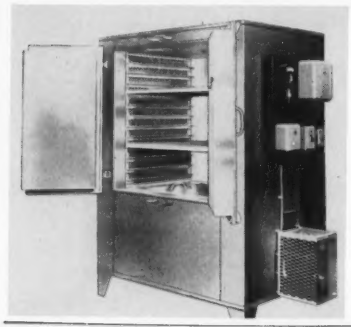
For further information circle No. 23

'PSC' RADIANT TUBES in
Any Design or Dimension
Send for PSC Heat-Treat Catalog 54
PSC fabricated tubes furnish four substantial advantages: (1) Light-wall construction saves furnace time and fuel. (2) Return bends are of same wall thickness as tubes, promoting uniform flow of gas. (3) Smooth dense walls minimize carbon build-up and burn-out. (4) Up to 100% longer life. In any alloy, size or type, including parabolics. Also sheet-alloy heat-treating retorts and covers, boxes, baskets, fixtures, tubes, etc.
PSC
THE PRESSED STEEL CO • Wilkes-Barre, Pa.

For further information circle No. 24

Portable Oven

The Carl Mayer Corporation of Cleveland, Ohio, has recently added a new line of portable industrial ovens for use in closely-controlled production and laboratory work. These heavy-duty cabinet ovens are available with either horizontal or vertical air flow. They employ a high-pressure, motor driven blower to propel the heated air in a definite air-flow pattern through the work chamber. This prevents any disturbance due to radiant heat, and assures temperature uniformity.



For further information circle No. 25

To

Those concerned with

QUALITY HEAT TREATING

No other method presently in use can match the uniform heating produced by the recirculation of hot gases.

The flow of hot gases properly channeled through the work in sufficient volume constitutes the most efficient heating obtainable.

Temperatures from 300°-1800° F. can be held within extremely close limits.

Homogeneous penetration of carbon in carbonitriding and carburizing is accomplished by the use of effective recirculating fans.

For example: automotive piston pins are carburized to a case depth of .040" to .050" more uniformly and in a shorter time in a furnace in which the active gases are recirculated. This recirculation is produced by special alloy fans.

In lower temperature "*Circ-Air*" furnaces high velocity fans force the hot gases through the work with no temperature head. Thus thin and thick sections heat more evenly. The entire work load comes to heat uniformly. Only in a "*Circ-Air*" furnace heated by recirculation can this type of heat control be achieved.

"CIRC-AIR"

Get More Facts About Recirculation—

Write

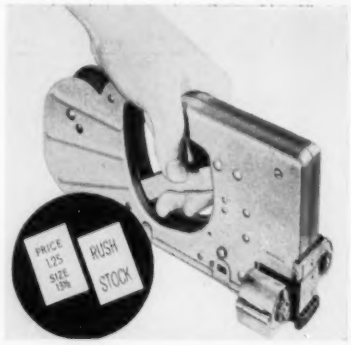
INDUSTRIAL HEATING EQUIPT. CO.

3570 FREMONT PLACE • DETROIT 7, MICHIGAN

For further information circle No. 53

Label Dispenser

The Trig-A-Tape Corporation, New Rochelle, N. Y., has announced a line of portable label attachers for one-hand operation. A squeeze of the trigger on the compact, light-weight unit cuts and attaches a self-adhesive paper label. The size of labels dispensed are either ¾" x 1⅛" or ¾" x ⅝" and can be written on with pen, pencil or crayon.



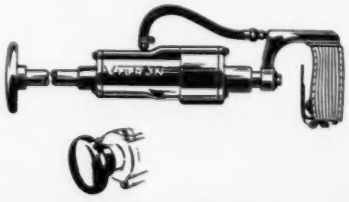
Two models are available, the T-2 which dispenses blank labels, and the T-3 which automatically prints labels as they are applied. The printing model is equipped with a removable snap-on chase which permits simple changes of type for marking, pricing, etc.

Tapes are available in white and colors and can be pre-printed with company name or other information. The T-3 model can be supplied with ribbons in various colors. The use of a ribbon for printing eliminates the need for inking.

For further information circle No. 26

Refractory Rammer

Maintenance and cost-conscious heat-treating plants, steel mills, foundries, forging shops,



(Continued on page 37)

new partly-automatic batch furnaces (of the Ipsen or Lindberg types) involves a problem of investment very difficult to solve. The commercial shops are owned by individuals, and the self-investment policy which has prevailed up to now cannot be further maintained on account of the steady fall of the prices spurred by a harder and harder competition.

Those who will survive must find some means to resolve this arduous problem without losing their independence or their freedom.

Amalgamations or concentrations of commercial shops would be desirable, but unfortunately such concepts are not in favour owing to a specifically French turn of mind. French business men are reluctant to lose their authority, their prerogatives and their independence. The result is a waste of means of production at the prejudice of the national interests. The French manufacturer prefers an economic deadlock to a voluntary "hari-kiri" because he fears he would give up his liberty in becoming a partner with someone else more powerful than himself.

The next few years to come will bring big transformations and changes in the French corporation of commercial heat treaters because undoubtedly that industry will have to reach a higher technical level. The lesson of the productivity mission to the United States has not been lost and will contribute to some more uniformity in the techniques that are conditioning the rise of the standard of living in our respective countries. ■ ■ ■

and similar industries can now cut to a minimum the downtime for the application and the patching of refractory through the use of a new pneumatic rammer manufactured by the Vibron Division of the Burgess-Sterbentz Corporation, Cleveland, Ohio.

Made of a bronze lined alloy aluminum body, the rammer is precision fitted with a hard chrome piston to insure dependable, trouble-free service. The rammer itself is designed so that its maintenance is held to a minimum cost by the elimination of costly seal and bearing replacements.

The rammer operates at the usual shop air pressure. A quick-connect coupling is furnished to permit simple and rapid connection of the ¼-inch air supply line to the rammer.

Normally supplied with a circular ramming head three inches in diameter, the rammer can be equipped with shafts of varying length and heads with larger or smaller diameters or irregular shapes, depending on the requirements of the work.

For further information circle No. 27

Gas Flame Supervision

The Safety Equipment Division of Control Engineering Corporation, Norwood, Massachusetts, has announced the release of their new Twin Flame

HEAT AND CORROSION RESISTANT
CASTINGS & FABRICATIONS
RADIANT TUBE ASSEMBLY
This General Alloys Company design combines castings and fabrications to obtain the best features of each for optimum performance and service life. The fabricated straight sections are light in weight and provide for maximum efficiency of heat transfer. The cast return bends offer maximum resistance to gas erosion and eliminates the welded area susceptible to early failure resulting from flame impingement. These tubes are available in many shapes and sizes. Let our engineering staff help you solve your heat resisting alloy problems.
GENERAL ALLOYS COMPANY
403 WEST FIRST STREET • BOSTON 27, MASSACHUSETTS

For further information circle No. 28

DEMPSEY FURNACES

GAS, OIL AND ELECTRIC
BATCH • CONTINUOUS

ATMOSPHERIC - RECIRCULATING - PUSHER — ROTARY HEARTH — CONVEYOR - RADIANT TUBE - POT CAR-BOTTOM - ALUMINUM REVERBS.

"Tailored by Dempsey"

DEMPSEY INDUSTRIAL FURNACE CORP.
Springfield 1, Mass.

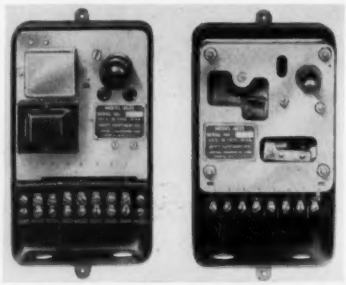
For further information circle No. 31

LP GAS INSTALLATIONS and ANHYDROUS AMMONIA PLANTS

More than 80 Peacock Plants prove . . .
"There's No Substitute For Experience"

PEACOCK CORPORATION
Box 268, Westfield, N. J.
Westfield 2-6258

combustion safeguard system specifically designed for gas-fired industrial equipment.



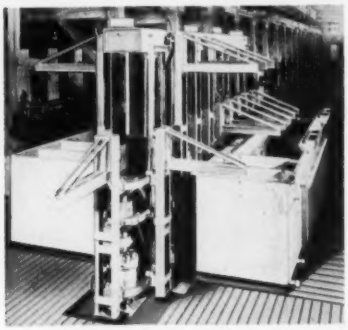
The effective utilization of constant impinging flames to complete an electrical path in a voltage responsive system has eliminated flame rods and photocells completely. Separate Programmer and Flame Detector units provide economical, positive, and continuous flame supervision by flame itself. Multiple burner installations are also feasible.

Simplicity of Twin Flame design offers ease of adaptation to industrial gas burners and pilots currently employed in industry. It is stated that loss of production time and materials are reduced to a minimum through the elimination of a high percentage of false shutdowns.

For further information circle No. 29

Plating Machine

Details of the new Stevens "Stevadoer" Automatic Heavy-Duty Plating and Processing Machine have just been announced.



This new side arm type machine was engineered around an "automation concept" that will enable automatic loading and unloading. It can be adapted to single or double row plating and processing and was design to handle almost unlimited rack sizes and extreme weights. However, only a minimum amount of height and floor space is required.

A delayed set-down mechanism which provides independent timing in one or more tanks can be provided. The "Stevadoer" is mechanically flexible—additional transfers can be easily provided. Through the use of a special timer control, a carrier arm can be made to skip any particular tank or operation as desired.

A 20 inch or wider cat walk can be provided between processing tanks and the mechanism on two-row machines. This permits safe and easy addition and removal of anodes, lubrication and inspection. No moving mechanism is over the solutions and all internal mechanisms are built below tank level.

For further information circle No. 30

Tempilstiks°

quick, simple, accurate way to tell temperatures

It's this simple: mark the workpiece with the proper Tempilstik°. When the mark melts, the specified temperature has been reached.

use like a crayon

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150	300	550	1100	1650
163	313	600	1150	1700
175	325	650	1200	1750
188	338	700	1250	1800
200	350	750	1300	1850
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For further information circle No. 32

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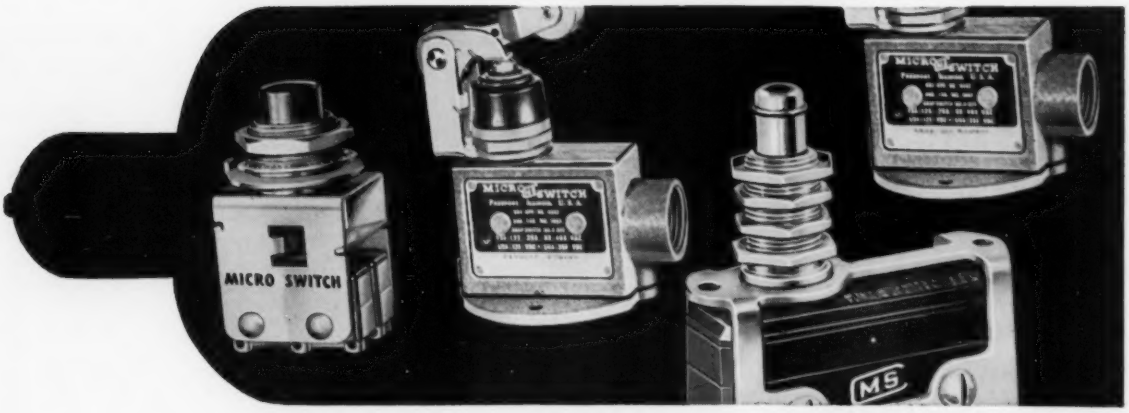

Carbonitriding with Armour ammonia holds the precision parts to watchmaker's tolerances – assures long life, high capacity and accurate repeatability

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Lloyd Froning, Tool Room Supervisor
Micro Switch Division of
Minneapolis-Honeywell Regulator Co.

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THE APPRENTICE CORNER

Editor's Note: *The following column appears regularly in METAL TREATING and is designed to aid young men who have only recently started in the heat treating industry. If you would like to see specific subjects discussed, or if you have any questions, let us know what they are.*

KEEP THAT SHAPE!

Naturally, anyone who invests time and money in tools or machine parts wants to see them come through heat treatment with the least possible distortion and hopes they will not crack.

So, too—let us hasten to add—does the heat treater!

Not only is this true because excessive warpage may cause breakage but also because one of the main problems is to maintain original shapes.

Not infrequently the professional heat treater is asked, "How much will this piece warp?" He usually can judge, when shown the part or a sketch of it, whether or not much movement is likely. But this answer must be a guess, for several reasons. For one thing, there is no way he can gage the internal stresses which will *release* during heat treatment. Frankly, the best way to predict would be to treat the piece then revise the treatment if necessary.

A careless patron may send out a job with instructions merely to "harden this straight!" Such an order is obviously too vague and leads to trouble, for not only does it fail to say what the straightness tolerance actually is but it does not state how much stock has been left for grinding. It shows complete ignorance of the fact that many parts are simply bound to come out of the quench distorted, and nobody on earth can stop it.

There are many causes of distortion. Parts that are quite regular in section may not stay straight when hardened. Long, thin strips or bars—or long rods of small diameter—rarely hold their original shapes, even when quenched vertically as they should be.

The same can be said about plates and disks. Both are inclined to warp and "dish." Moreover, warpage becomes more probable as lengths increase, or thicknesses diminish.

Here is a valuable hint—you will do well to remember it: *when steel is heated, it does not dilate the same amount in cross section as it does* with *the grain!*

Troubles like the foregoing may not be avoidable. But often distortion can be avoided by a little planning or forethought. This includes intelligent selection of steel for the job.

All too frequently, a particular steel is chosen merely because it happens to be easy to machine. That in the long run may prove to be poor economy. For while there just is *no such thing* as a truly nondeforming (or "no-change") steel, some types are far less likely to warp than others simply because a quench can be employed that is less drastic.

Your steel supplier knows this, and will gladly assist you if you but ask him. He will explain that the higher the alloy content of steel, the slower it must be cooled (quenched) to obtain maximum hardness. A water-hardening steel might be entirely wrong to use since it would have to be cooled rapidly. So, for an unbalanced, delicate job he would probably recommend an oil-hardening steel or even an air-hardening type, since air quenching is the slowest and least severe.

Occasionally, one should consider using mild, low-carbon, carburizing steels; for while they will distort, their soft core makes them easy to straighten and there is practically no danger of breakage.

(Material contributed by A. S. Eves, Chief Field Engineer, Perfection Tool and Metal Heat Treating Co., Chicago, Ill. We regret mention of this was omitted from our last issue.) ■ ■ ■

ABSTRACTS

Job Shops: Six Paths to Profit

(*Steel*, May 2, 1955)

Contract manufacturers are worried about unsatisfactory earnings. A survey conducted by the editors of *Steel* of ten progressive jobbers reveals these major factors for success: (1) better facilities; (2) know-how; (3) engineering service; (4) better selling; (5) economical production; and (6) diversification.

"Job shops are the buck privates of the industrial army." That's the half-humorous definition of contract manufacturing by one executive in the business.

He and others who make tooling, produce parts or perform services to the order of other manufacturers are concerned about dependence upon their customers. Contract manufacturers see competition rising, prices and profits generally slipping and break-even points climbing.

Nobody knows just how many job shops exist among the 56,000 metalworking plants in the U. S. Tabulation is difficult because many are both contractors and users of their own product. Probably more than half the 56,000 plants do some contract manufacturing.

Of about 6000 foundries in this country, 75 per cent are principally job shops. Yet they make only an estimated 55 per cent of all castings produced. Castings users turn out the rest. Therein lies a major problem for contract manufacturers. Their share of total production has been dropping since the end of World War II.

Thus, contract manufacturers have a double-edged, competitive problem—competition from their customers with captive shops and from other job shops. That competition has forced prices down, or, at the best, has kept them stable over the last 18 months.

Costs have risen for job shops just as they have for everyone else. With prices stable or down, the squeeze is on.

Under the circumstances, what can contract manufacturers do to assure good profits? Plenty. *Steel* went to ten of the many job shops it considers successful to learn their formulas for success.

All ten firms agree that modern equipment is the most important (or one of the most important) paths to profit. Superior equipment not only enables a company to do work faster, easier and cheaper, but it should permit a job shop to do special work that few can do. That's the essence of many a contract manufacturer's success. *Metallurgical, Inc., a Minneapolis heat treater* employing 50, finds that 20 per cent of its customers have heat-treating facilities of their own. It still gets their work because of its specialized apparatus.

"We know what we can do. From long experience, we work well together. That's important to get quality, speed and low unit costs. It's an area where small plants have a big advantage over large ones," says one Cleveland executive.

"Once you get good equipment, you have to have well-trained people to operate it," says Mr. Koch, who started his stamping shop training in his teens as a sweeper. A stable work-force with low turn-over is a must, he believes.

Even larger job shops, such as Cleveland's Barth Corp., which employs 300, stress company and the employee experience. Selling tools, dies and special equipment, Barth is a family operation (as are many job shops). It's operated by the four Barth brothers, Glenn, Tom, John and Robert.

A third skill common to all good contract manufacturers is high-class engineering service.

"Our chief advantage over another company which has heat treating facilities but doesn't specialize in that alone," says L. A. Lindberg, "is our technical service." Mr. Lindberg is president of *Lindberg Steel Treating Co.*, which employs 325 at its main Chicago plant, 40 at Los Angeles and 25 each at St. Louis and Rochester, N. Y., facilities.

"We have a staff of metallurgists," he points out, "who consult with customers on their jobs. We prefer to be in on the ground floor, so that the customer doesn't make a poor application."

Better selling is the fourth common attribute of successful contract manufacturers.

The trend: More publication advertising, more direct mail, more technical literature. *Lindberg Steel Treating* has a publication, *After Hours,* sent to customers and potential customers, which is designed to show the importance of heat treating in everyday life. It also distributes several customer aids, such as hardness conversion and tempering charts.

Many jobbers have more salesmen on the road now than a year ago. Look, too, for more sales stress on economy. Carter C. Higgins, president of Worcester Pressed Steel Co., Worcester, Mass., and Clement C. Caditz, president of Northern Metal Products Co., Franklin Park, Ill., are outstanding among a group of crusaders selling job shops via magazine articles and speaking tours.

Their theme: Make or buy? They and others in the business agree that it often makes sense for a large user of stampings or castings to install his own facilities to make the component, produce the tooling, or perform the service.

Contract manufacturers like Messrs. Higgins and Caditz point out that often the case for "doing it yourself" is not too clear cut. They urge better cost accounting procedures to determine whether the capital expenditure is justified, whether labor would be intelligently used in a peripheral operation, whether quality would be up to a job shop's standards.

Jobbers hope to get more business by putting the spotlight on some expensive captive operations. While they're finding that many smaller captive shops are as efficient as their own, they have had considerable success with their campaign. For example, of about 150 gray iron foundries that went out of business in 1954, more than half were captives.

A sixth approach to profit for job shops is diversification—either an end product or through additional contract manufacturing lines. Not all jobbers favor diversification, but enough do to make the practice common. End-product diversification is the toughest. It involves sales setups that few contract manufacturers have.

Contract manufacturing capacity increased markedly during and after World War II. The decline in defense work has hit it hard. No wonder a tough transitional period worries job shops.

But they always will be needed. General Motors Corp. spent 52.8 per cent of its 1953 sales dollar with suppliers. Chrysler Corp. spent 65.8 per cent.

"Contract manufacturers serve as the bellows of industry," said the late James Forrestal, the first Secretary of Defense. "If they are the buck privates of industry, they are as vital as the enlisted men in any army."

Heat Treating Water-Hardening Tool Steels

By Manley & Brumbach
(Steel, January 31, 1955)

In quenching a tool of the water-hardening type the first stage is called the vapor blanket stage. The hot metal is surrounded by a thin vapor film. In this stage the cooling is relatively slow because the heat transfer is by conduction and radiation through this film. The wetting of the metal surface marks the end of this stage.

The second, or vapor transport stage, is a fast cooling one because the vapor forms in bubbles and is carried away by convection currents to condense in the surrounding liquid which is cooler. Finally, as the surface temperature of the metal approaches the boiling point of the quenching liquid, the third, or liquid cooling stage, begins, and the heat loss is relatively fast by means of conduction and convection.

Certain precautions must be taken. All water-base quenching media have about the same cooling characteristics in the vapor transport stage, but a quench solution of from 5 to 10% sodium hydroxide will minimize soft spots and help uniform hardening. Sometimes glycerine-water mixtures containing from 10 to 40% glycerine are useful.

The danger of forming soft spots due to steam pockets is greatly reduced if the quench water is circulated rapidly or used as a spray. These methods tend to eliminate the causes of soft spots such as decarburization, tong marks and adhering scale.

Dimensional characteristics of water-hardening tool steels are also important. The dimensional change in a tool of the water-hardening type depends upon both the mass and the hardenability of the steel. Small sizes of deep hardenability that harden throughout will expand. Large sizes of shallow hardenability will shrink. Intermediate sizes having a critical hardenability value will not change dimension.

The important things to note are these: (1) the tool should be cooled to a low enough temperature so that sufficient martensitic structure exists; (2) tempering should be started as soon as possible after hardening; and (3) sufficient time should be allowed in drawing for the tools to reach the temperature of the furnace. A good rule to follow here is to allow 20 minutes per inch of the thickest section. To do this the heat treater must decide from the size and shape of the work how long a tool should be drawn and then select the temperature that will give him maximum toughness and hardness. ■ ■ ■

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INSTITUTE NEWS

MTI Holds Spring Meeting

The 1955 Spring Meeting of the Metal Treating Institute which took place at The Ambassador in Los Angeles, Calif., May 9th, 10th and 11th, was well attended by more than half the membership from all parts of the country.

The program got underway with a "Get Together Breakfast" for members and their wives on Monday morning. This was followed by a technical session at which Mr. Harry Brenner of Olympic Screw Products Co. presented a talk on "Titanium" and Mr. Graham Hall of Armco Corp. spoke on the subject of "Precipitation Hardening of Stainless Steel."

Tuesday morning was devoted to a tour of Douglas Aircraft Co., Inc.

A technical session was held on Wednesday morning at which Mr. Allen Neithammer of Pacific Metals Co., Ltd. presented a talk on "Nickel Alloys as Used in Heat Treating Furnaces and Equipment" and Mr. John Franklin of The Sanford Company spoke on "The Sanford Process." Mr. Mel Hall of Reynolds Metals Co. also presented a paper on the subject of "Heat Treatment of Aluminum." This was followed by a business meeting.

The afternoons and evenings of the three days were given over to a well-rounded program of tours and special entertainments planned by a committee of West Coast members. Mr. Robert Fish of Lindberg Steel Treating Co., Mr. Richard Smith, Jr. and Mr. Richard Smith, Sr. of Cook Induction Heating Co., Mr. Arlo Leidig of Hollywood Heat Treating Co., Mr. Daniel F. Malloy of Malloy Heat Treating Co., Mr. W. W. Farrar of Valley Metal Treating Co. and Mr. Ted Krumwied of Aluminum and Magnesium Heat Treating Inc. guided the planning of a most informative and enjoyable three days.

A special program of tours and luncheons was planned to occupy the ladies during the morning business and technical sessions until they could join the men for the afternoon and evening events. We would like to thank Mrs. Arlo Leidig, Mrs. W. W. Farrar, Mrs. Richard Smith, Jr., Mrs. Robert Fish and Mrs. Daniel Malloy for their efforts in making this part of the program a success.

Although the meeting officially closed with a "Chuckwagon Dinner" at the home of Mr. & Mrs. W. W. Farrar on Wednesday evening, many of the members stayed over to take part in an all-day outing to Catalina Island on Thursday.

IHEA Spring Meeting

The annual Spring meeting of the Industrial Heating Equipment Ass'n. was held at The Homestead, Hot Springs, Virginia, on May 15-18.

Horace Drever, President of the Drever Company, Philadelphia, and also President of IHEA, presided.

Among the speakers were Charles W. Stewart, Executive Vice President of the Machinery & Allied Products Institute, who discussed "Leasing of Industrial Equipment and Realistic Depreciation Policy."

J. W. Rex, President of the J. W. Rex Company and past President of the MTI spoke on "What the Commercial Heat Treating Industry Would Like To Have the Industrial Heating Equipment Manufacturers Develop." Mr. Rex's talk was a resume of needed technical improvements in the commercial heat-treating field.

The Honorable Calvin W. Johnson, Ass't. to the President of the Remington Rand Company discussed trends in American business and economic life.

New Vincent Officers

The Vincent Steel Process Co., Detroit, Mich., announced the election of E. O. Schram as President and Treasurer of the Company succeeding the late K. H. Behringer.

For further information circle No. 54

LETTERS TO THE EDITOR

Editor's Note: *R. S. replies to Cost Accounting Chairman Jenks' letter. (See March-April issue, p. 37.)*

Dear Editor:

I do not wish to monopolize this column, but trust that you will permit me a few more lines on the recent "Cost Accounting" Papers.

I am indebted to the Chairman of the Cost Accounting Committee for his reply to my letter, but I have evidently not made myself entirely clear when I raised the question of accuracy in the determination of job costs.

I was referring to the costing of a product or job prior to manufacture—that is, the calculation of a selling price which would guarantee a profit while still maintaining competitiveness. With this in mind, I expressed in my first letter some doubt as to the accuracy of the methods recommended to establish (1) the labor times required to do a job and (2) the determination of departmental or plant operating efficiency, two factors which greatly influence the final selling price.

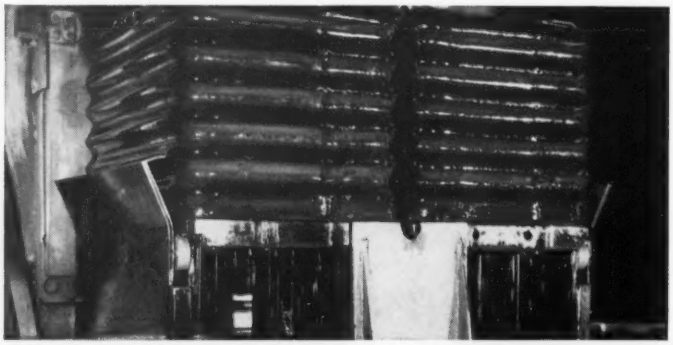
I was more than surprised to read that in the Chairman's book, the data based on facts and data based on experience are the same animal.

If you should ask three qualified men to determine labor requirements and operating efficiency on the basis of their experience, I am sure that you would get three different answers according to their experience. If you should, therefore, use such information to price your products or your job, you are bound to obtain three different prices.

To avoid such differences which can be very costly in a highly competitive market, I recommended the use of Standard Data rather than individual experience to determine labor requirements and operating efficiency. Accuracy in this phase is as important as in any other stage of Cost Accounting.

May I briefly explain, to those who are not familiar with the use of Standard Data, how they operate: Standard Data are predetermined operating times established from Time Studies. When pricing a job, the times required for individual operations are added together from prepared charts to produce a total job time. This time is an accurate indication of how long it should take to perform a certain task or do a certain job. Any variances between the time we actually take and the time specified by the standards can then be expressed as a percentage factor. This is a true factor of operating efficiency.

It is obvious now, that with the use of Standard Data, we can not only determine accurately the manufacturing time on any job before it actually passes into the shop, but we can also determine what adjustments we must make



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Provides clean, bright-quenched parts at lower cost ... keeps tanks and coolers cleaner longer.

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For further information circle No. 55

to our calculated price to allow for plant and labor inefficiencies.

We have, therefore, in this method not only a very accurate pricing procedure, but also a very quick indicator to show where our prices step out of line and where to take corrective actions.

I note from the Chairman's letter that the Cost Accounting Committee has never been willing to sacrifice accurate unit costs for the sake of simplicity. I am sure, therefore, that the suggestion of incorporating Standard Data in a cost system based on individual unit costs will be well taken.

R. S.
Management Engineer

Dead Editor:

Recently I had the opportunity to see the January-February issue of METAL TREATING and it was of great interest to me. I would appreciate it if you could provide me with the necessary information on how to obtain a copy regularly. In our commercial work it is necessary that heat treating be controlled and I am sure this periodical would be of service to us.

A. P. COLLER, Div. Staff Supvr.
Manufacturing Engineering
Westinghouse Electric Corp.
Philadelphia 13, Pa.

Ed.—Mr. Coller qualifies to receive METAL TREATING *and has been added to our circulation list.*

Dear Editor:

If it is possible we would like to get thirty (30) copies of the article "How to avoid heat treating difficulties through correct design of press tools" by Federico Strasser. The article was printed in the January-February 1955 issue of METAL TREATING.

We would like to use the article as reference and instructional material for our tool designers and tool making apprentices.

S. F. DOWNEY, Project Engineer
Monroe Calculating Mach. Co.
Orange, N. J.

Ed.—Six copies sent followed by reprints of the article.

Dear Editor:

Considerable interest has been shown by some of our members in an article published in your January-February issue.

The article to which we refer is "Application of Nitriding to Hot Forging Dies," by Alexander F. Sherys.

Could you please send us one-half dozen copies of this particular issue which we would like to distribute to some of our interested members. This favor will be sincerely appreciated.

If there is any cost connected with supplying these copies please forward your invoice and we will be happy to reimburse you.

MARVE NARRAMORE,
Staff Assistant
Drop Forging Association
Cleveland, Ohio

Ed.—Six copies sent.

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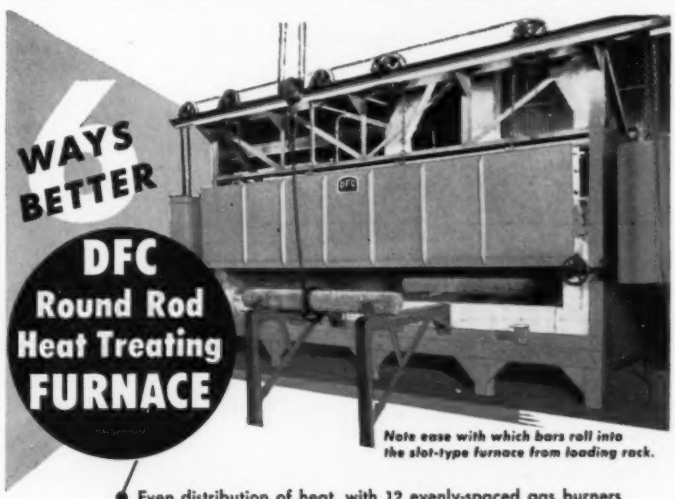

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For further information circle No. 56

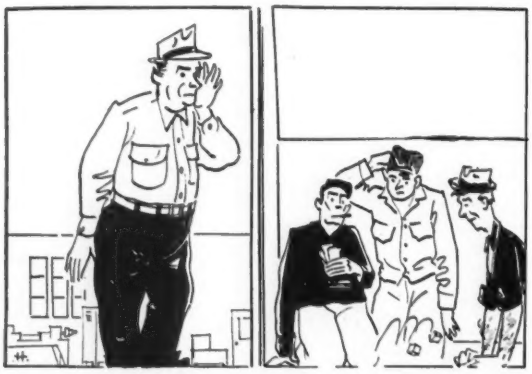
Right Or Wrong In

LABOR RELATIONS

By **LAWRENCE STESSIN**

Editor's Note: *This department presents, in each issue, a round-up of day to day in-plant problems and how they were handled by management. Each incident is taken from a true-life grievance which went to arbitration. Sources of these cases will be given upon request.*

Can you fire a group of employees for gambling even though you didn't catch them red-handed?



What Happened:

Harvey Jackson, a foreman, was walking by a closed office in the corner of the plant. He heard the roll of dice, the jingling of coins and voices placing bets. He listened; and a few minutes later he went down to the superintendent's office.

"Those three are gambling again," he said.

"Same ones we caught last month?" the head man asked.

"I guess so," replied the foreman. "I didn't break in but I heard them making bets."

"Okay, fire them," he was told.

The foreman returned to his floor and found the three men leaving the room. He stopped them, told them that he was firing them for gambling, and instructed them to pick up their pay at the cashier's window. The men didn't say a word. They left the premises as ordered, but the next day filed a grievance. The dispute finally ended up before a 3-man arbitration board. The fired workers put up the following defense:

The foreman did not *see* the men gambling.

Although these men were caught gambling previously, they hadn't been told that they would be fired if caught again.

The company had no 'published anti-gambling' rule. Others had been caught gambling previously, and not fired.

The company's case centered around these arguments:

Gambling is a punishable offense in all industry whether there is a written rule or not.

Admittedly, the men were fired on circumstantial evidence, but such evidence is as good in industry as it is in any court of law.

If the men were innocent, why didn't they say so when the foreman fired them.

Was the Company: RIGHT ☐ WRONG ☐

What the Arbitration Board Ruled: "Previous leniency in similar cases in no way deprives the company of its inherent right to run the plant as efficiently as it can, and to discharge for just cause. If the charge of the company that these men *were* gambling was not true, it is the duty of the men involved to have come forward and give an explanation of what they were doing when they were where they had no right to be. The fact that they did not do so at the time of discharge, coupled with the auditory evidence and previous pattern of behavior, sustains the company's position and contention."

Can an employer require that "overtime" be worked in the morning?

What Happened:

The morning shift began at 7:30 A.M. and ended at 4:00 P.M. Because of an increase of business, the company changed the starting hour to 6:30 A.M., paying overtime for that extra hour. The workers affected complained because this was a change in the scheduled work-hours and required negotiations in accordance with the union contract. The company said "No." It maintained there was no change in the regular hours because only the starting time was different—the quitting time remained the same. The employees came up with another argument. Overtime, by custom, can only be scheduled after regular hours—not before. Thus, there would be less of a compulsion to work the extra time if some employees preferred not to stay over the quitting time. The company said this was true, but it couldn't schedule overtime at the end of the first shift because it would interfere with the start of the second shift.

Was Management: RIGHT ☐ WRONG ☐

What Arbitrator Joseph M. Klamon Ruled: "Overtime occurs most frequently *after* a regular schedule of 8 hours. It also occurs frequently after 40 hours of work in a week or on the 6th or 7th day of the week, or when work is required on a holiday. Essentially it is *extra work* that may be required outside of the regular or normal work schedule. If circumstances require it, there is no reason why extra or overtime work cannot be performed *before* the beginning of the normal schedule, as well as after the regular work hours. In this case it was not possible, as indicated, to have the overtime work performed *after* the 7:30 A.M. to 4:00 P.M. shift because the next or succeeding shift would come on at 4:00 P.M. and would require much of the space and equipment utilized by the preceding shift. The *extra* or *overtime* hour of work was, therefore, required not after the end of the regular schedule of work, but immediately preceding the start. Management has the right of scheduling overtime work and all employees are required to work overtime when they are scheduled. This clearly comes within the company's right to manage the plant. In this case the management exercised its prerogative by requiring one hour of overtime to be worked before the beginning of the regular work shift, and followed the contract requirement that the employees be allowed to work their full regular shift in addition to the one hour of overtime. This did not constitute a change in the regular schedule of hours. Grievance denied."

Must an employer fill a "temporary" vacancy?

What Happened:

The company had a policy which read: "When it is known that a job will be temporarily vacant for 5 or more days for any cause, every effort will be made to fill the temporary vacancy by the senior employee on the next step." Lowell, a maintenance man went on a 5-day leave. His assistant, Bill Stanley, insisted that he be given Lowell's job and rate of pay until the senior man returned. The company refused to do this. It claimed that there is no "must" for filling temporary vacancies—that management has the right to decide which jobs shall be vacant and which jobs filled. Otherwise it couldn't run an efficient plant. It further held that once a "temporary vacancy" has been filled, then and only then is it bound by the rule to give the opening to the next senior man.

Was the Company: RIGHT ☐ WRONG ☐

What Arbitrator Joseph Klamon Ruled: "To adopt the worker's position would be to *obligate* the company to fill all jobs where the company knows that a man will be absent for at least five days. Management alone, under its inherent rights to operate a plant as efficiently as it can, must decide that question. The company *alone* must decide when the filling of a vacancy becomes *necessary*. The company *alone* must decide if and when it becomes necessary to move men to fill such temporary vacancies. Once the decision is made by the company that it is *necessary* to fill such vacancies, then and then only do the provisions of the written rule become operative. Grievance denied." ■ ■ ■

MANUFACTURERS' LITERATURE

For your copy circle the number on the Readers' Service Card

Millivoltmeter Controls

New technical literature is available to those interested in the application of automatic control equipment to the solution of industrial process control problems from the Barber-Colman Co., Rockford, Ill.

The new sixteen page bulletin discusses conventional millivoltmeter construction and its application to a control instrument. Also described is the function of an oscillator circuit in a pyrometer controller, along with various control forms which can be developed from this type circuit.

For further information circle No. 35

Pipe Line Filters

Its line of Type "PL" Pipe Line Filters, designed for removal of water, oil, dirt and pipe scale from compressed air or gas lines, is detailed in a new brochure now available from the Air-Maze Corporation, Cleveland 28, Ohio.

The filters have been engineered for pressures up to 150 lbs. gauge. Standard models are furnished for pipe sizes to 2" while special models are available to 6" pipe size. Design features include extremely low pressure drop which does not exceed three ounces; ease of disassembly for inspection purposes; permanent type separator-element which may be easily cleaned in hot water; an element of brass and bronze construction; corrosion-proof steel shell; cast-iron head, threaded inlet and outlet connections; an absence of moving parts; hydrostatically pressure tested to 250 lbs., psi.

For further information circle No. 36

Waste Treatment

A new bulletin discussing industrial, municipal and industrial waste treatment equipment is available from Graver Water Conditioning Co., New York, N. Y.

A concise discussion of the basic types of equipment available for treatment is included along with photographs of typical installations. The advantages of industrial waste treatment are presented as well as the types of municipal equipment available.

For further information circle No. 37

Induction Heating

A 12-page booklet describing induction heating equipment for the metal-working industry is available from the Westinghouse Electric Corporation, Pittsburgh, Pa.

Induction heating typical applications for forging, hardening, annealing and metal joining are discussed.

Many types of work-handling equipment designed to handle the more common operations are explained. Also, specialized work-handling machines designed to handle all types of manual or automatic operations on a wide variety of work piece sizes and shapes are described.

In addition to complete control and work facilities, a description of the work station housing for all components such as output transformers, capacitors, plumbing for quench and cooling water, contactors, and timers is presented.

For further information circle No. 38

High Alloy Castings

The Duraloy Company, Scottdale, Pa., has issued a new general 16-page bulletin which describes in detail its facilities for producing high alloy static and centrifugal castings and gives engineering data concerning castings used for resisting high temperatures, corrosion and abrasion. Two pages are devoted to "Physical Properties of High Alloy Castings" and another to standard designation of such castings as adopted by the Alloy Casting Institute. One section is devoted to the many different alloying combinations and their broad uses.

For further information circle No. 39

COOLING TOWER PUMPS

A new manual for sizing cooling tower pumps and piping has been published by Bell & Gossett Company, Morton Grove, Illinois.

The 8-page manual illustrates the use of six steps to select an efficient and economical cooling tower pump and piping combination.

For further information circle No. 40

RAYOTUBE DETECTOR

A concise data sheet, N-3(1), is available from Leeds & Northrup Company describing the L&N line of Rayotube (radiation-type) temperature detectors. The sheet covers use of these detectors for either direct sighting applications to measure the temperature of stationary or moving surfaces or for sighting into closed-end target tubes to measure the temperature of a furnace atmosphere or other medium. Specifications

(*Continued on page* 50)

NOW

a high-speed Quenching Oil that gives all-purpose performance

Here's why metal-working plants everywhere are changing to Shell Voluta Oil 23

1. **High cooling rate through the critical temperature range.** To develop maximum physical properties, various carbon and low alloy steels require higher cooling rates than provided by conventional mineral type quenching oils. Shell Voluta Oil 23, because of its initial cooling rate, helps develop these desired properties in such steels.

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Quenching from cyanide into Shell Voluta Oil 23 gives exceptionally clean part surfaces . . . often eliminates the need for after-quench cleaning.

The cooling rate of Shell Voluta Oil 23 is high through the critical range, while its rate of cooling during martensitic transformation is essentially that of conventional oil. This combination is ideal for minimizing distortion tendencies.

3. **Stability in Service.** Extreme resistance to sludging and viscosity change has been achieved through the careful selection of well-refined base stocks and the use of special additives. Shell Voluta Oil 23 stays the same physically AND retains its high cooling rate. *Write for further details.*

SHELL OIL COMPANY

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100 BUSH STREET, SAN FRANCISCO 6, CALIFORNIA

SHELL

For further information circle No. 41

give Rayotube characteristics; list metal and ceramic sighting tubes; and discuss both open-and closed-end types of mountings.

For further information circle No. 42

Vapor Degreasing

The Ramco Equipment Corp. has published a bulletin describing vapor degreasing, its advantages and the latest equipment available.

The bulletin illustrates when vapor degreasing may be used to free metal surfaces from grease, oil, resin, wax or lubricants—before electroplating, assembly, heat treating, inspection and testing, or enameling, painting, lacquering—or after stamping and drawing—or between machining operations.

In diagrammatic drawings, it illustrates the basic fundamentals of vapor degreasing and how it works to dissolve oil and grease with solvent vapors of trichlorethylene and perchlorethylene.

For further information circle No. 43

Hardness Tester

A bulletin has recently been issued by Gries Industries, Inc., New Rochelle, N. Y., describing and illustrating the Wolpert-Gries "Micro-Reflex" hardness tester with optical system by Carl Zeiss, designed for loads from 10 gram to 3000 gram.

The bulletin outlines some of the many important applications of this apparatus, such as: hardness tests of hard layers below 0.1 mm (0.004") in thickness; very thin metal sheets and foils; small, highly stressed parts of watches and small driving gear; layers of metal plating; small precision tools, particularly at edges; and micro-constituents of the structure of metals and alloys.

For further information circle No. 44

Plastic Fabrications

Atlas Mineral Products Company, Mertztown, Penn., has recently completed the publication of an eight page bulletin on rigid plastic fabrications and pipe. The bulletin outlines the use of Type I polyvinyl chloride in the fabrication of exhaust systems, process equipment, and processing tanks. Resistance characteristics and physical properties of the plastic are included in the section.

Also included in this comprehensive bulletin is a section on plastic pipe and fittings. Description and tables on chemical and physical properties of Type I and II polyvinyl chloride and styrene copolymer rubber resin blend rigid plastic pipe is included.

For further information circle No. 45

CONTROL CATALOG

A new edition of the price list and specification catalog, P1260, for furnace and oven control instruments and accessories has been released by The Bristol Company of Waterbury, Conn.

Containing detailed specifications and engineering data necessary for choosing the proper pyrometers and control equipment for heat treating, metal processing or other industrial heating applications, the bulletin describes and illustrates all components required in such a system, including electric control relays, motor operators and controllers, and electric and air-operated control valves.

For further information circle No. 46

LIFT TRUCK OPERATOR'S BOOKLET

The sixth printing of "How to Operate a Lift Truck" has been completed by Hyster Company and the 24-page booklet is now available to lift truck operators, supervisors, safety engineers and other interested industrial and governmental people.

The two-color cartoon technique used in the booklet is designed for easy reading and is packed with information about the operation of a lift truck, preventive maintenance, safety and basic materials handling.

For further information circle No. 47

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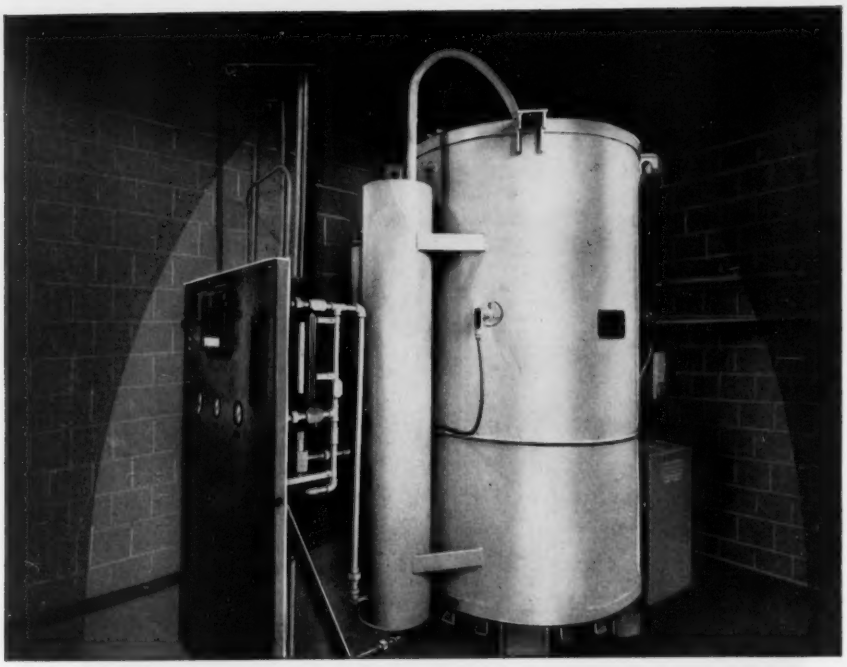
CRUCIBLE STEEL COMPANY OF AMERICA
Pittsburgh, Pa.



"Cracked" Ammonia shows tremendous cost saving and unsurpassed performance

1 —Bright Annealing—Stainless Steels, Nickel and Nickel Alloys, Beryllium Copper, Silicon Copper Alloys and Bronzes, and high and low carbon steels.

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the Drever

Ammonia Dissociator

produces the ideal protective furnace atmosphere

DREVER COMPANY

We can supply COMPLETE STORAGE SYSTEMS for tank car lots of anhydrous ammonia. This reduces the cost of ammonia approximately 75%. *Write for bulletin B-52*

RED LION ROAD & PHILMONT AVE., BETHAYRES, PA.

For further information circle No. 48

one is always out front

...and with high speed steels the pace setter is **REX**

Crucible's REX high speed steels have been way out in front ever since their introduction. And today they're still the *standard for comparison* wherever high speed steels are used.

There are many good reasons for REX's leadership – uniformity of size, structure, finish, response to heat treatment, tool performance. Each factor can be proved in your own shop, on your own work. So try this *standard for comparison* on a few jobs and you'll agree with thousands of users – *you can't find a high speed steel to outperform REX.*

Because of its extensive, nationwide use, REX high speed steel is carried in stock by the coast-to-coast chain of Crucible warehouses, or is available on quick mill delivery. *Crucible Steel Company of America, Henry W. Oliver Building, Pittsburgh 22, Pa.*

CRUCIBLE first name in special purpose steels

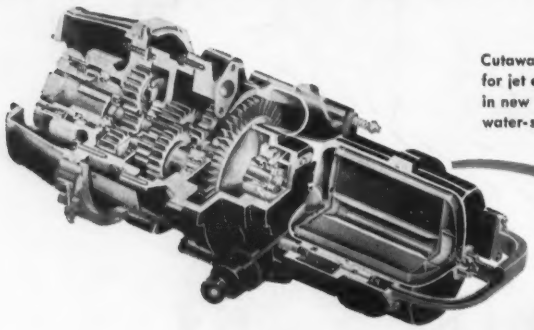
Crucible Steel Company of America

For further information circle No. 49

Rapid deep case

for jet engine starter clutch

with new AEROCARB® carburizing compounds



Cutaway of a General Electric gas turbine starter for jet engines shows clutch components they carburize in new high-speed, high-temperature, water-soluble AEROCARB Carburizing Compounds.

Sleek new Martin B-57 jet light bomber has starters housed in streamlined pods seen at each engine air intake opening.

Clutch mechanisms for gas turbine starters must deliver tremendous power to bring jet engines to starting speed. To get the toughness and strength they need, General Electric Company's Aircraft Accessory Turbine Dept. at Lynn, Massachusetts, carburizes these parts in Cyanamid's new, high-speed, high-temperature AEROCARB S and (as the bath replenisher) AEROCARB R Carburizing Compounds.

Chief feature of these new AEROCARB compounds is deep and rapid penetration with minimum distortion. Many of the parts require 0.060" case depth, which G-E achieves at 1650-1750° F in just 8-9 hours with AEROCARB water-soluble salts. They use the same salt bath for their short time, shallow case work. Drag-out from this bath is low; wash-off is fast, easy, and complete with warm water.

These remarkable new AEROCARB carburizing compounds can solve your case hardening problems — give you high quality results in less time and at lower cost. The attached coupon is for your convenience.

For further information circle No. 50

Cyanamid's heat treating compounds include:	*Other products for metal processing include:*
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AEROCARB® Case Hardening Compounds	Metallic Stearates
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MT1-55

AMERICAN Cyanamid COMPANY

METAL CHEMICALS SECTION

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☐ Send technical data sheet on AEROCARB S

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